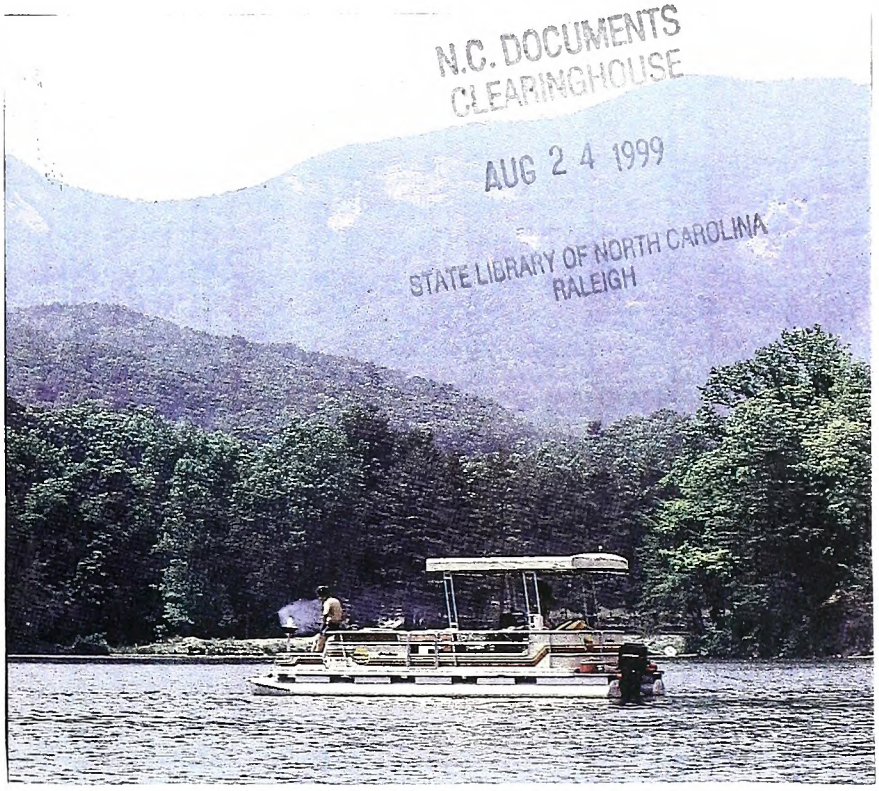
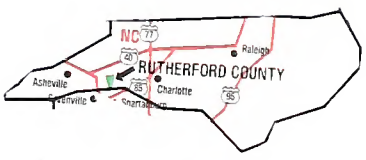
North Carolina Department of Transportation
Division of Highways
Statewide Planning Branch

THOROUGHFARE PLAN REPORT FOR THE RUTHERFORD COUNTY URBAN AREA





MARCH 1999

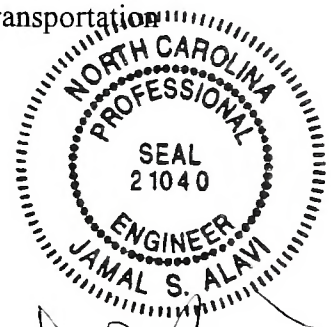
Rutherford County Urban Area Thoroughfare Plan

Prepared by the:

Statewide Planning Branch
Division of Highways
North Carolina Department of Transportation

In Cooperation With:

The Town of Alexander Mills
The Town of Bostic
The Town of Forest City
The Town of Ruth
The Town of Rutherfordton
The Town of Spindale
The Rutherford County
The Federal Highway Administration
U.S. Department of Transportation



March 1999

Jamal . S. Alavi, P.E.
Transportation Planning Engineer

Acknowledgments

Persons responsible for this report:

Project Engineer:	Jamal S. Alavi, P.E.
Engineering Associate:	Jennifer D. Harrison, E.I.T.
Urban Planning Unit Heads:	Jerry Dudeck, P.E. Rick Blackwood, P.E.
Group Manager:	Blake Norwood, P.E.
Manager Statewide Planning Branch:	M. R. Poole, Ph.D., P.E.
Transportation Technician:	Charles Tew

Executive Summary

This plan documents the findings of a thoroughfare study for the Rutherford County Urban Area. Below is a listing and brief description of these findings that are of major significance:

Major Thoroughfares

1. **US 221 Bypass (Rutherfordton Bypass) -** A 4 lane facility on new location is recommended to be constructed from US 221 in the northern part of the planning area to US 64, north of US 74 A; to West Street, east of US 74 A; to Thunder Road; connecting back to US 221 in the southern part of the planning area. The bypass would also reduce traffic on Main Street/US 221 by moving local and through traffic out of the central business district (section of TIP Project R-2233).

2. **US 221 (Rutherfordton) -** This facility is expected to increase in capacity significantly by the design year and is recommended to be widened to a four lane facility from Old Highway 221 north to McDowell County. This widening is already programmed in NCDOT's Transportation Improvement Program (TIP Project R-2597). The portion south of the intersection with the proposed US 221 Bypass to the South Carolina border, is programmed for widening in NCDOT's Transportation Improvement Program (section of TIP Project R-2233).

3. **US 74 A -** This facility is 2 lane from US 64 to US 74 Business in Rutherfordton and is expected to exceed capacity from Whitesides Road to US 74 Business by the design year. A 4 lane facility is recommended for the section between Whitesides Road and US 74 Business to alleviate congestion. US 74 A from US 74 Business to Oakland Road is adequate.

4. **Alexander Mills Connector (US 74 A Extension) -** A 4-lane facility on new location connecting US 221 A and US 74 A at the US 74 interchange is recommended to relieve congestion on US 221 A in Alexander Mills.

5. **Broadway/Powell One-way Pair -** This recommendation involves creating a one-way pair north of Grace Street. Broadway Street (north of Grace Street) is recommended to be converted into a northbound one-way street and Powell Street (north of Grace Street) is recommended to be converted into a southbound one-way street. The proposed one-way pair will increase the capacity of the existing streets and therefore provide for a better level of service.

6. **Bostic Road (SR 1006) -** This two lane facility connects Forest City to the Town of Bostic. Bostic Road is not expected to experience any capacity problems within the planning period. The only problem on this facility occurs at the railroad crossing in central Bostic where stopped trains regularly block Bostic Road. The blocked road is an inconvenience and creates a safety hazard since it delays emergency vehicles. A new thoroughfare east and south of Bostic will allow traffic to bypass the blocked road. This proposed two-lane thoroughfare would be an extension of the Gun Club Road, cross Old Bostic Road east of the existing elementary school, cross Bostic Road and would tie into the proposed East-West

Connector. Bostic Road is recommended to be extended south as a 4-lane facility, from US 74 Business to connect to Old Caroleen Road north of the US 74 interchange. This extension will provide direct access to US 74. Old Caroleen Road is recommended to be widened to a 4-lane facility from this point to the US 74 interchange to accommodate the expected traffic.

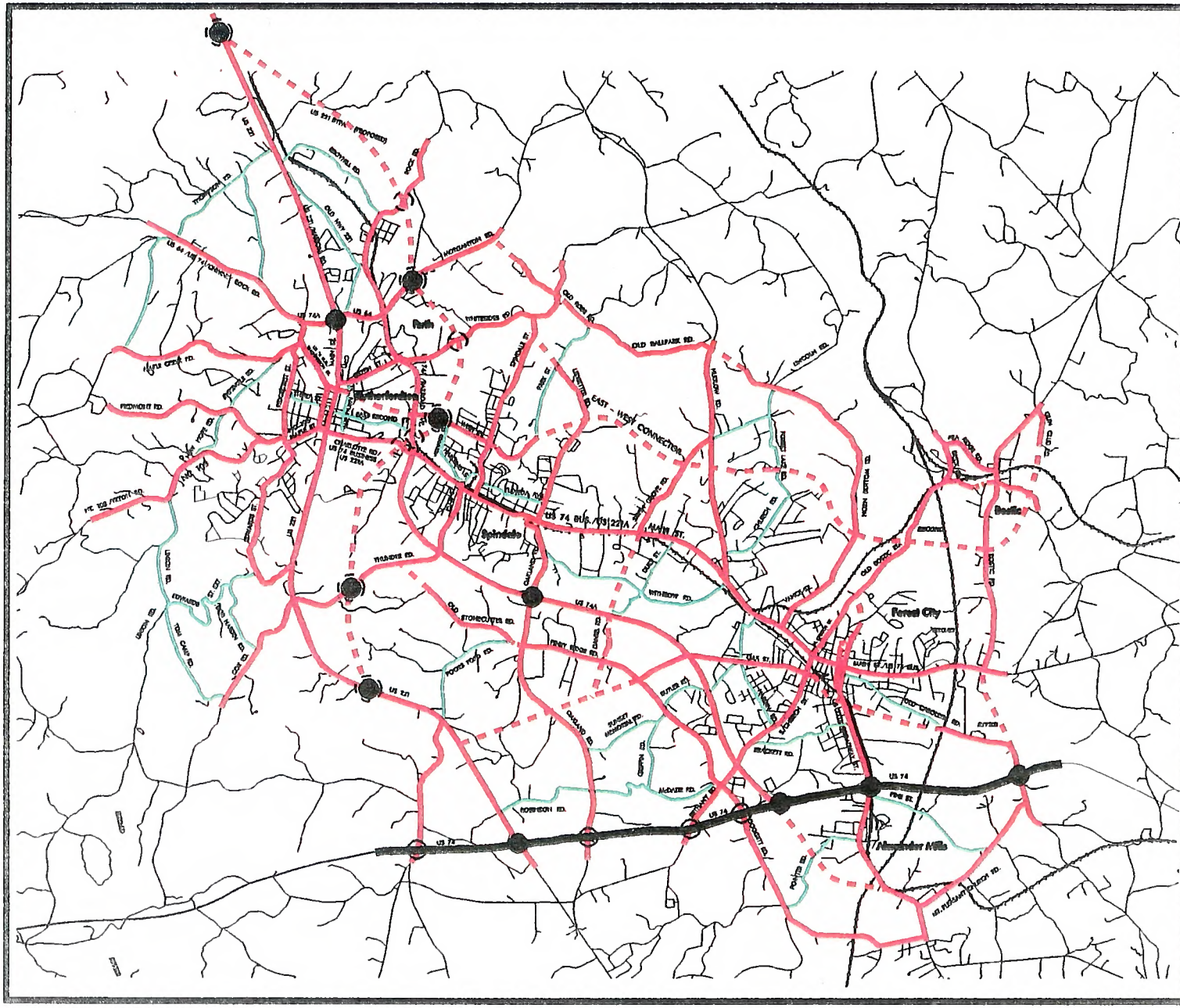
7. **Broadway Street/US 221A** (US 74 Business to south of Alexander Mills) - Broadway Street is the most direct route from Forest City to Alexander Mills and connects US 74 Business to US 74 Bypass and US 221 south of the planning area. Broadway street is a 2 lane road and is operating at capacity. Broadway Street is recommended to be widened to a 5-lane curb and gutter section to accommodate the present and future traffic.

8. **Oak Street (Forest City)** - Oak Street is currently congested from Hardin Street to US 74 A and by the design year (2010), Oak Street will be operating at or above capacity on its entirety. Oak Street is recommended to be widened to 5-lane curb and gutter from South Church Street to Piney Ridge Road. This widening is already programmed in NCDOT's Transportation Improvement Program (TIP Project U-2711).

9. **Oak Street Extension** - It is recommended that Oak Street be extended east to Broadway Street/US 221A and Old Caroleen Road; and west to Oakland Road and US 221.

10. **East-West Connector** - This will provide an alternate to traveling on Main Street from Rutherfordton to Bostic. This facility will relieve congestion on Main Street while providing access for future development. The East-West Connector will provide an attractive route for traveling across the northern planning area, drawing traffic from congested parallel facilities and leading travelers more directly to their destinations. The East-West Connector is proposed to be constructed as a 2-lane facility. The proposed Connector will connect US 74 Business and Main Street in Rutherfordton to Bostic Road utilizing some existing roads (Seventh Street, West Street and Park Street) and parts on new location.

11. **West Street (SR 1544)** - This route will increase in volume by the design year due to its connection with the proposed East-West Connector. It is recommended that the lanes be widened from 9 foot lanes to 12 foot lanes to provide for the increasing demand in the design year. It is recommended to extend West Street to the west from US 74 A to US 221. This will improve Rutherfordton's connectivity to the proposed East-West Connector.



RUTHERFORD COUNTY URBAN AREA THOROUGHFARE PLAN

LEGEND

	EXISTING	PROPOSED
FREEWAY / EXPRESSWAY		
MAJOR THOROUGHFARE		
MINOR THOROUGHFARE		
INTERCHANGE		
GRADE SEPARATION		

PUBLIC HEARING MEETINGS: APRIL 30, 1997
AUGUST 21, 1997

ADOPTED BY

FOREST CITY	September 15, 1997
RUTH	September 1, 1997
RUTHERFORDTON	September 9, 1997
SPINDALE	September 22, 1997
ALEXANDER MILLS	September 8, 1997
BOSTIC	September 1, 1997
RUTHERFORD COUNTY	September 8, 1997
RECOMMENDED APPROVAL BY STATEWIDE PLANNING BRANCH	October 17, 1997
NC DEPT. OF TRANSPORTATION	November 7, 1997

JULY 31, 1997

RUTHERFORD COUNTY URBAN AREA

RUTHERFORD COUNTY
NORTH CAROLINA

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS – STATEWIDE PLANNING BRANCH
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

0 2000 4000 6000 8000
feet
0 1000 2000 3000
kilometers

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A - Thoroughfare Planning Principles

Chapter 1

Introduction

Overview

Officials of the Rutherford County Urban Area, prompted by a desire to adequately plan for the future transportation needs of the area, requested the North Carolina Department of Transportation's (NCDOT) assistance in conducting a thoroughfare plan study. The primary concern of the Rutherford County Urban Area's officials was the increased congestion on US 221 in the Central Business District of Rutherfordton and what could be done to alleviate this problem. The local officials were also concerned about the location of the proposed US 221 Bypass in the Transportation Improvement Program (TIP# R-2233).

The objective of thoroughfare planning is to enable the transportation network to be progressively developed to adequately meet the transportation needs of a community or region as land develops and traffic volumes increase. By not planning now for our future transportation needs, unnecessary costs to the physical, social, and economic environment may very well be incurred. Thoroughfare planning is a tool that can be used by local officials to plan for future transportation needs, while at the same time reducing the costs to our environment.

The primary purpose of this report is to present the findings and recommendations of the thoroughfare plan study conducted for the Rutherford County Urban Area. The secondary purpose of this report is to document the basic thoroughfare planning principles and procedures used in developing these recommendations. This report can be divided into five parts. The first part of the report, covered in Chapter 1, covers the highlights of the study. Chapter 2 and 3 provide a detailed description of the Thoroughfare Plan study recommendations and address different methods by which these recommendations can be implemented. The next chapter, Chapter 4, covers study procedures and findings. Chapter 5 and 6 provide a detailed description of population, land use and environmental concerns that were looked at while developing this plan. The final chapter, Chapter 7, covers traffic model development.

Information that will be especially useful to the practitioners is provided in the Appendix. The principles of thoroughfare planning are covered in Appendix A. A detailed tabulation of all routes on the Thoroughfare Plan and a graphical representation of typical cross-sections can be found in Appendix B and C respectively. Information related to subdivision ordinances is covered in Appendix D.

Background

Rutherford County is situated in the foothills of the Blue Ridge Mountains and the Black Mountains of the North Carolina. It is within the easy driving distance to Asheville (45 miles), Charlotte (70 miles), and Spartanburg, South Carolina (30 miles). Rutherford County was named for Brig General Griffith Rutherford, a revolutionary Patriot. Rutherford County offers a relaxing lifestyle and a vibrant industrial climate.

The Rutherford County Urban Area comprises six towns and the immediate area. These towns are Alexander Mills, Bostic, Forest City, Ruth, Rutherfordton, and Spindale. Figure 1 shows the geographic location of the Rutherford County Urban Area.

Highlights

Major highlights of the 1997 Rutherford County Urban Area Thoroughfare Plan are outlined below. The Thoroughfare Plan map is shown in Figure 2. Projects included in the 1997-2003 Transportation Improvement Program (TIP) are shown in parenthesis.

1. **US 221 Bypass (Rutherfordton Bypass)** - A 4 lane facility on new location is recommended from US 221 in the northern part of the planning area to US 64, north of US 74 A; to West Street, east of US 74 A; to Thunder Road; connecting back to US 221 in the southern part of the planning area. This facility would carry 10,000 vehicles per day in 1997 and 15,000 vehicles per day in 2010. The bypass would also reduce traffic on Main Street/US 221 by moving local and through traffic out of the central business district (section of TIP Project R-2233).

2. **US 221 (Rutherfordton)** - This facility is expected to experience increases in traffic significantly by the design year and is recommended to be widened to a four lane facility from Old Highway 221 north to McDowell County. This widening is already programmed in NCDOT's Transportation Improvement Program (section of TIP Project R-2597). The portion south of the intersection with the proposed US 221 Bypass to the South Carolina border, is programmed for widening in NCDOT's Transportation Improvement Program (section of TIP Project R-2233).

3. **Alexander Mills Connector (US 74 A Extension)** - A 4-lane facility on new location connecting US 221 A and US 74 A at the US 74 interchange is recommended to relieve congestion on US 221 A in Alexander Mills. US 221A is a heavily traveled facility, 1997 ADT was recorded at 14,600. The projected traffic on this proposed connector is estimated to be 12,600 in the year 2010.

4. **Oak Street (Forest City)** - Oak Street is currently congested from Hardin Street to US 74 A (1997 Average Daily Traffic estimated to be 11,000 vehicles) and by design year (2010), Oak Street will be operating at or above capacity on its entirety, with an anticipated ADT of 11,800 to 16,000 (Piney Ridge Road to South Church Street).

   Oak Street is recommended to be widened to 5-lane curb and gutter from South Church Street to Piney Ridge Road. This widening is already programmed in NCDOT's Transportation Improvement Program (TIP Project U-2711).

5. **Oak Street Extension** - It is recommended that Oak Street be extended east to Broadway Street/US 221A and Old Caroleen Road (2010 projected ADT is 16,000); and west to Oakland Road and US 221 (2010 projected ADT is 12,000).

6. **East-West Connector** - It will provide an alternate to traveling on Main Street from Rutherfordton to Bostic. This facility will relieve congestion on Main Street while providing access for future development. The East-West Connector will provide an attractive route for

traveling across the northern planning area, drawing traffic from congested parallel facilities and leading travelers more directly to their destinations.

East-West Connector is proposed to be constructed as a 2-lane facility. The proposed Connector will connect US 74 Business and Main Street in Rutherfordton to Bostic Road utilizing some existing roads (Seventh Street, West Street and Park Street) and parts on new location. The projected 2010 ADT is estimated to range from 4,700 to 10,000.

7. **West Street (SR 1544)** - This route will increase in volume by the design year due to its connection with the proposed East-West Connector. The 1997 estimated ADT from US 74 A to Spindale Street is 3,300, while the design year anticipated volume is estimated to be 10,000. It is recommended that the travel lanes be widened from 9 foot lanes to 12 foot lanes with shoulder to provide for safer travel in the design year.

   It is recommended to extend West Street to the west from US 74 A to US 221. This will improve Rutherfordton's connectivity to the proposed East-West Connector. The projected 2010 ADT on this extension ranges from 6,200 to 6,700.

The North Carolina Department of Transportation and the Rutherford County Urban Area are jointly responsible for the proposed thoroughfare improvements. Cooperation between the State and the Rutherford County Urban Area is of primary concern if the recommendations outlined above are to be successfully implemented. The plan has been mutually adopted by all parties, and it is the responsibility of the Rutherford County Urban Area to implement the plan following guidelines set forth in Chapter 3. This plan was adopted by Forest City on September 15, 1997; Ruth on September 1, 1997; Rutherfordton on September 9, 1997; Spindale on September 22, 1997; Alexander Mills on September 8, 1997; Bostic on September 1, 1997; Rutherford County on September 8, 1997; and by the North Carolina Department of Transportation on November 7, 1997.

It is important to note that the recommended plan is based on anticipated growth within the Rutherford County Urban Area as indicated by past trends and future projections. Prior to construction of any of these projects, a more detailed study will be required to revisit development trends and to determine specific locations and design requirements.

GEOGRAPHIC LOCATION FOR RUTHERFORD COUNTY URBAN AREA NORTH CAROLINA

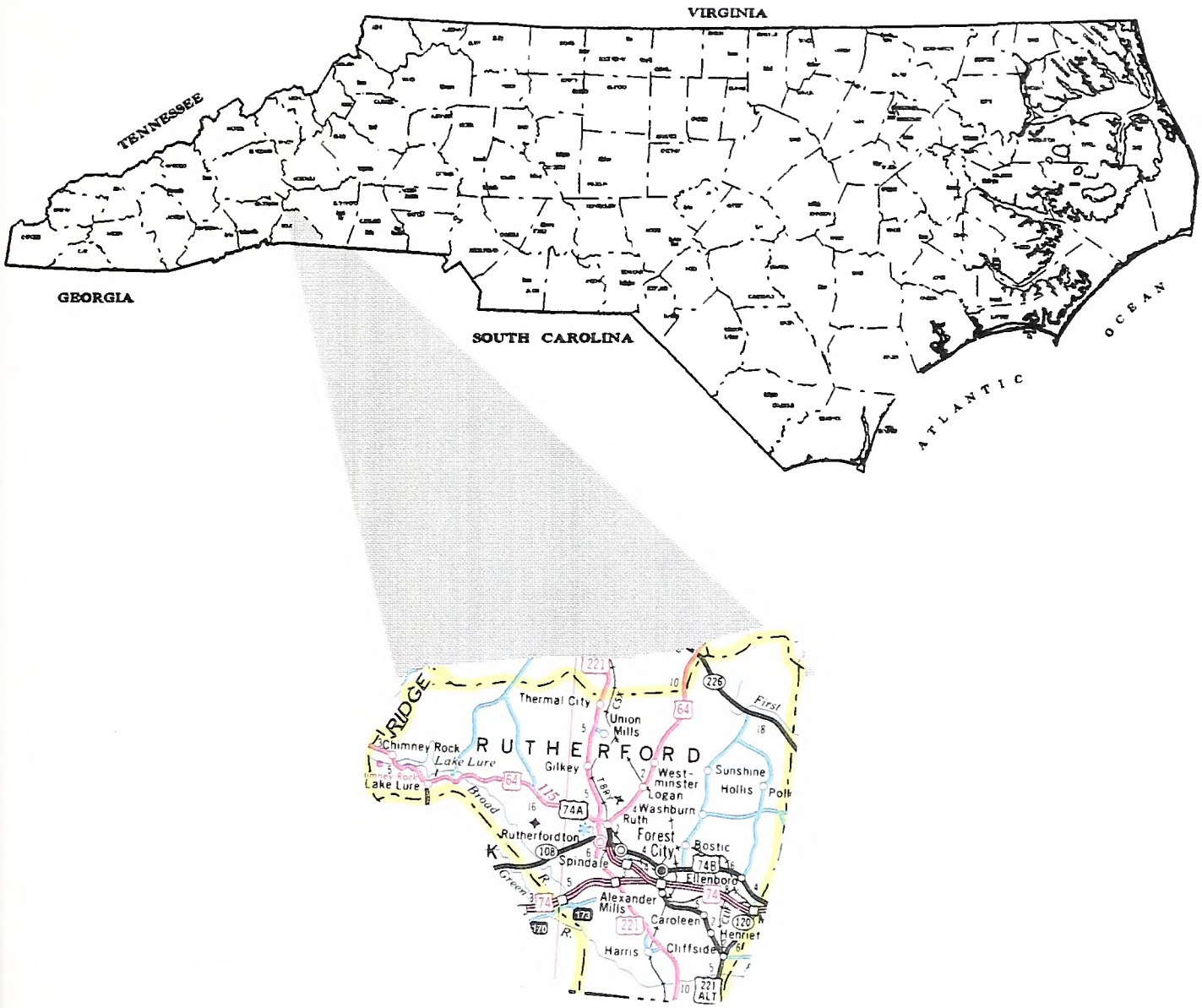

FIGURE 1

RUTHERFORD COUNTY URBAN AREA THOROUGHFARE PLAN

LEGEND

	EXISTING	PROPOSED
FREEWAY / EXPRESSWAY	———	- - - -
MAJOR THOROUGHFARE	———	- - - -
MINOR THOROUGHFARE	———	- - - -
INTERCHANGE	●	◌
GRADE SEPARATION	○	◌

PUBLIC HEARING MEETINGS: APRIL 30, 1997
AUGUST 21, 1997

ADOPTED BY

FOREST CITY	September 15, 1997
RUTH	September 1, 1997
RUTHERFORDTON	September 9, 1997
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RECOMMENDED APPROVAL BY STATEWIDE PLANNING BRANCH	October 17, 1997
NC DEPT. OF TRANSPORTATION	November 7, 1997

N

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JULY 31, 1997

RUTHERFORD COUNTY

URBAN AREA

RUTHERFORD COUNTY

NORTH CAROLINA

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS – STATEWIDE PLANNING BRANCH
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

0 2000 4000 6000 8000
feet

0 1000 2000 3000
kilometers

FIGURE 2

1. East-West Connector
2. Daniel Road Extension - north from US 74 A to US 74 Business
3. Oak Street - improvements from Piney Ridge Road to South Church Street
4. Oak Street Extension - west from Piney Ridge Road to Oakland Road
5. Oak Street Extension - east to Old Caroleen Road
6. US 74 A Extension/Alexander Mills Connector
7. Broadway Street - widening from US 74 Business to south of Alexander Mills
8. South Church Street Extension - north to connect to North Church Street
9. Old Bostic Road - improvements from Brick Road to Bostic Road
10. Gun Club Road Extension - to proposed East-West Connector
11. Bostic Road Extension - south to Old Caroleen Road
12. Daniel Road - improvements from US 74 A to Piney Ridge Road
    - extension south to Oak Street Extension
13. Oakland Road - realignment at US 74 Business
14. Oak Street Extension - west from Oakland Road to US 221
15. Old Stonecutter Road - improvements at Oakland Road
16. Old Stonecutter Road Extension - west to Thunder Road
17. Ledbetter Road Extension - north to Spindale Street
18. Horn Bottom Road Extension - north to Hudlow Road
19. Old Ross Road Extension - west to US 64/Morganton Road
20. US 221 Bypass
21. US 74 A - widening from Whiteside Road to US 74 Business

RUTHERFORD COUNTY URBAN AREA RECOMMENDED PROJECTS

LEGEND

- Proposed Improvements
- # Project Reference Number
- Proposed Interchange
- Proposed Grade Separation

FIGURE 3

RUTHERFORD COUNTY URBAN AREA

RUTHERFORD COUNTY

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0 2000 4000 6000 8000
feet
0 1000 2000 3000
kilometers

Chapter 2

Recommended Thoroughfare Plan

Intent of the Thoroughfare Plan

Transportation is the backbone of a region's economic vitality. Without an adequate transportation system people cannot easily reach their intended destinations, goods cannot be delivered to the market in a cost effective manner, and investors may look to invest in better served areas. Recent trends such as regional economies, "just in time" delivery, increased automobile ownership, and increased migration away from the central cities and town are taxing our existing transportation system and requiring that we put more emphasis on planning for our transportation future.

A thoroughfare plan study identifies existing and future deficiencies in the transportation system, as well as uncovers the need for new facilities. The thoroughfare plan also provides a representation of the existing highway system by functional use. This use can be characterized as a part of the major or minor thoroughfares plus any new facilities that are needed. A full description of these various systems and their subsystems is given in Appendix A.

This chapter presents the thoroughfare plan recommendations. It is the goal of this study that the recommended plan set forth a transportation system that will serve the anticipated traffic and land development needs for the Rutherford County Urban Area. The primary objective of this plan is to reduce traffic congestion and improve safety by eliminating both existing and projected deficiencies in the thoroughfare system.

Thoroughfare Plan Recommendations

Freeways:

Freeways are multi-lane, controlled-access facilities designed to carry large volumes of traffic at high speeds. US 74 is the planning area's only freeway. US 74 is expected to operate well under capacity and no improvements are recommended for this facility.

Major Thoroughfares:

These are facilities that provide for the expeditious movement of high volumes of traffic within and through the urban area. The following roads are major thoroughfares which are recommended for improvement.

Alexander Mills Connector (US 74 A Extension) - A 4-lane facility on new location connecting US 221 A and US 74 A at the US 74 interchange is recommended to relieve congestion on US 221 A in Alexander Mills. US 221 A is a heavily traveled facility, 1997 ADT was recorded at 14,600. The projected traffic on this proposed connector is estimated to be 12,600 in the year 2010. (Figure 3 - #6)

US 64/Chimney Rock Road - This two lane facility is a connector between Rutherfordton and Ruth and is expected to be sufficient through the design year. The 1997 ADT ranges from 3,100 to 8,000 and the projected 2010 ADT is estimated to be from 5,000 to 9,400.

US 74 A - This facility is 2 lane from US 64 to US 74 Business in Rutherfordton and is expected to exceed capacity from Whitesides Road to US 74 Business by the design year. A 4 lane facility is recommended for the section between Whitesides Road and US 74 Business to alleviate congestion since the 2010 estimated traffic is 16,500. The 1997 ADT is near capacity already and is 13,000. US 74 A from US 74 Business to Oakland Road is adequate. US 74 A from Oakland to US 74 has a 1997 ADT of 18,000 while the projected 2010 estimated ADT is 25,000. (Figure 3 - #21)

US 221 - This two lane facility provides a through route from the northern planning area to the southern planning area through Rutherfordton. The 1997 ADT is 6,000 and the projected 2010 ADT ranges from 5,000 to 10,000 with the exception of the northern portion to Thompson Road. This northern portion has a 1997 ADT of 5,700 and the projected 2010 ADT is estimated to be 15,000. The widening of this facility from Old Highway 221 north to McDowell County is already programmed in NCDOT's Transportation Improvement Program (section of TIP Project R-2597). The portion south of the intersection with the proposed US 221 Bypass to the South Carolina border, is programmed for widening in NCDOT's Transportation Improvement Program (section of TIP Project R-2233).

US 221 Bypass (Rutherfordton Bypass)- A 4 lane facility on new location is recommended to be constructed. This route would alleviate traffic on US 221, allowing through traffic to bypass the central business district in Rutherfordton and would serve both Ruth and Rutherfordton due to its central location . Its expected 2010 ADT is projected to range from 4,000 to 15,000. (section of TIP Project R-2233). (Figure 3 - #20)

NC 108 (Tryon Road) - This two lane facility in the western portion of the planning area is adequate for future traffic demands and no improvements are recommended during the planning period. The 1997 average daily traffic from the western planning area boundary to Ridgecrest Street ranges from 2,600 to 4,000. The projected design year daily traffic is expected to range from 4,400 to 6,400.

Broadway/Powell One-way Pair - This recommendation involves creating a one-way pair north of Grace Street. Broadway Street (north of Grace Street) is recommended to be converted into a northbound one-way street and Powell Street (north of Grace Street) is recommended to be converted into a southbound one-way street. The proposed one-way pair will increase the capacity of the existing streets and therefore provide for a better level of service.

Bostic Road (SR 1006) - This two lane facility connects Forest City to the Town of Bostic. Bostic Road is not expected to experience any capacity problems within the planning period. The projected 2010 ADT is estimated to range from 4,500 to 6,300, increasing from the 1997 ADT of 3,200 to 3,900. The only problem on this facility occurs at the railroad crossing in central Bostic where stopped trains regularly block Bostic Road. The blocked road is an inconvenience and creates a safety hazard since it delays emergency vehicles. A new thoroughfare east and south of Bostic will allow traffic to bypass the blocked road. This proposed two-lane thoroughfare would be an extension of the Gun Club Road, cross Old Bostic Road east of the existing elementary school, cross Bostic Road and would tie into the proposed East-West Connector. The 2010 estimated ADT of this connector is 8,400.

Bostic Road is recommended to be extended south as a 4-lane facility, from US 74 Business to connect to Old Caroleen Road north of the US 74 interchange. This extension will provide direct access to US 74. The projected 2010 ADT is 2000. Old Caroleen Road is recommended to be widened to a 4-lane facility from this point to the US 74 interchange to accommodate the expected traffic. (Figure 3 - #11)

Broadway Street/US 221A (US 74 Business to south of Alexander Mills) - Broadway Street is the most direct route from Forest City to Alexander Mills and connects US 74 Business to US 74 Bypass and US 221 south of the planning area. Broadway street is a 2 lane road and is operating at capacity (1997 ADT ranges 10,000 to 14,600). Broadway Street is recommended to be widened to a 5-lane curb and gutter section to accommodate the present and future traffic. The projected 2010 ADT is estimated to be from 10,000 to 20,000 on this portion. (Figure 3 - #7)

Charlotte Road/US 74 Business - This four lane route connects Rutherfordton to Spindale and Forest City. This route is mostly industrial and commercial (1997 ADT is 11,300). Charlotte Road should operate under or near capacity throughout the planning year (estimated 2010 ADT is 12,300) except for the section between US 221 and Maple Street/NC 108. Charlotte Road's intersections with Maple and Main Street require corrective improvements with regards to the vertical curve design, turning radius, proximity and number of driveways. These changes should improve the capacity, safety and level of service of the intersections.

Church Street (SR 2213) - South Church Street connects US 74A with US 74 Business/US 221A/Main Street in Forest City. The Oak Street Extension to Broadway Street and Old Caroleen Road will improve the traffic flow in Forest City such that Church Street will not need additional improvements. The 1997 ADT ranges from 5,500 to 5,800, while the projected 2010 ADT is estimated to be 6,500 to 6,800.

South Church Street is recommended to connect to North Church Street and North Church Street to connect to Old Bostic Road with a small extension at Luckadoo Street. This improved facility will provide for a north-south route from Bostic to US 74 A. (Figure 3 - #8)

Daniel Road (SR 2184) - Daniel Road which becomes Duke Street as it approaches US 74 Business, connects Piney Ridge Road to US 74A and US 74 Business. Daniel Road has substandard width and poor horizontal curve design. It is recommended to widen Daniel Road to a 24 foot road and shoulder section and enhance the horizontal curve design where appropriate. The 1997 ADT from Piney Ridge to US 74 A is 1,000 while the 2010 projected ADT is estimated to increase to 10,000 once it is extends from Oakland Road to US 74 A. The 1997 ADT from US 74 A to Withrow Road is 5,100, and the 2010 estimated ADT is 12,800. (Figure 3 - #12)

To provide better connectivity to US 74 Business and northern planning area, it is recommended that Daniel Road be extended north across US 74 A to US 74 Business at Smith Grove Road. This new two lane facility will provide more direct access to the proposed East-West Connector and a continuous north-south link through the center of the planning area. This northern extension has a projected volume of 4,000 in the design year. (Figure 3 - #2)

The intersection of Daniel Road and US 74 A is one of the high accident locations (See Table 5) in the planning area. It is recommended to improve the geometric design of this intersection (avoid a 5-legged intersection and enhance the horizontal and vertical curve design) to improve the sight distance and increase safety.

It is also recommended to extend Daniel Road south to the proposed western extension of Oak Street in Forest City. These facilities will provide better access to US 221 from the central planning area. The southern extension has a projected 2010 volume of 4,000. (Figure 3 - #12)

East-West Connector - This proposed facility will provide an alternate to traveling on Main Street from Rutherfordton to Bostic. This facility will relieve congestion on Main Street while providing access for future development. The East-West Connector will provide an attractive route for traveling across the northern planning area, drawing traffic from congested parallel facilities and leading travelers more directly to their destinations.

East-West Connector is proposed to be constructed as a 2-lane facility. The proposed Connector will connect US 74 Business and Main Street in Rutherfordton to Bostic Road utilizing some existing roads (Seventh Street, West Street and Park Street) and parts on new location. The projected 2010 ADT is estimated to range from 4,700 to 10,000. (Figure 3 - #1)

Edwards Street (SR 1153) - This two lane facility from Bob Hardin Road to Maple Street connects residential traffic to the downtown area of Rutherfordton. Edwards Street has a 1997 ADT of 1,700 and in 2010 the estimated ADT is 4,800. No improvements are recommended to this facility during this planning period.

Horn Bottom Road (SR 1533) - This 2-lane facility is a continuation of Vance Street. It is recommended to extend Horn Bottom Road to Hudlow Road at Old Ballpark Road in order to improve connectivity in northern planning area. Horn Bottom Road should also be widened from its current 20 feet to a standard 24 feet. The 1997 ADT of Horn Bottom Road north of the proposed East-West Connector is 600 and is estimated to be 1,000 in 2010. The 1997 ADT south of the East-West Connector is 4,400 and is estimated to be 7,500 in 2010. The expected ADT for the design year for the extension is 1,000. (Figure 3 - #18)

Hudlow Road (SR 1510) - This two lane facility from US 74 Business to the northern planning area boundary serves mostly residential traffic. The 1997 ADT for Hudlow Road from US 74 Business to Smith Grove Road is 6,800, while the 2010 projected ADT is estimated to be 9,000. The 1997 ADT for Hudlow Road from Smith Grove Road to the northern planning area boundary is 3,300, while the 2010 projected ADT is estimated to be 4,500. This facility should be widened from its current 20 feet to a standard 24 feet shoulder section.

Ledbetter Road - (SR 1591) - Traffic is well below capacity on this two lane facility; however, it is recommended that Ledbetter Road be extended north to Spindale Street in order to improve traffic flow in Spindale. The 1997 ADT ranges from 630 to 3,300, while the 2010 projected ADT is estimated to be 4,000. The Ledbetter Road extension to Spindale Street has a projected design year volume of 4,000. (Figure 3 - #17)

Main Street (US 221) in Rutherfordton - See US 221

Main Street (US 74 Business) from US 74A/Railroad Avenue to Bostic Road - This central radial connects Rutherfordton to Spindale and Forest City. The traffic in 1997 on Main Street ranges from 10,000 to 16,000 vehicles per day. Most of the Main Street corridor is heavily developed and the impact of any major widening will be tremendous. Parking could be improved or redesigned in some areas to provide more lane width and improve the traffic flow in the area.

Several improvements outside of removing parking and completely widening this facility are recommended below. The project providing the most extensive relief is the East-West Connector.

In general, parking, curb and driveway delineation are a major safety and capacity problem along Main Street. Multiple driveways should be consolidated and better delineated. If parking can not be removed as recommended, then parallel parking is recommended.

In the vicinity of Spindale, a one way pair with Wilson Street will increase the capacity and efficiency of Main Street. The traffic signal on Deveny Street needs to be actuated as it interrupts the flow of the traffic on Main Street.

The Oak Street Extension should help relieve congestion on Main Street in Forest City.

Oak Street (Forest City) - Oak Street is currently congested from Hardin Street to US 74 A (1997 Average Daily Traffic estimated to be 11,000 vehicles) and by design year (2010), Oak Street will be operating at or above capacity on its entirety, with an anticipated ADT of 11,800 to 16,000 (Piney Ridge Road to South Church Street).

Oak Street is recommended to be widened to 5-lane curb and gutter from South Church Street to Piney Ridge Road. This widening is already programmed in NCDOT's Transportation Improvement Program (TIP Project U-2711). (Figure 3 - #3)

Oak Street Extension - It is recommended that Oak Street be extended east to Broadway Street/US 221A and Old Caroleen Road (2010 projected ADT is 16,000); and west to Oakland Road and US 221 (2010 projected ADT is 12,000) as a five lane facility. (Figure 3 - #4, 5, 14)

Oakland Road - Traffic is below capacity on this two lane facility between US 74 and US 74 A for 1997 (ADT is 9,700); however, the design year estimated ADT is at capacity (11,000). Oakland Road from US 74 A to Piney Ridge Road has an estimated 1997 ADT of 7,000 and an estimated 2010 ADT of 8,000. The southern portion of Oakland Road, from Piney Ridge Road to the southern planning area boundary has a 1997 ADT of 4,700 and an estimated 2010 ADT of 6,800. There are no recommendations for the design period.

Old Bostic Road (SR 1576) - This two lane route has a 1997 traffic volume of 1,100 from Cherry Mountain Street to Bostic Road and is not anticipated to exceed capacity by the design year 2010 (projected to be from 1,500 to 2,400); however, improvements are recommended in the horizontal alignment of Old Bostic Road from Brick Road to Bostic Road. (Figure 3 - #9)

Old Caroleen Road (SR 1901) - This two lane facility will connect to the proposed extension of Bostic Road just north of its interchange with US 74. The 1997 average daily traffic ranges from 4,000 to 4,300. The design year projected volume is estimated to be 5,200 to 5,700. It is recommended that the portion of Old Caroleen Road from the Bostic Road Extension to the US 74 interchange be widened to 4 lanes. This will provide Bostic with a more direct connection to the southern Alexander Mills.

Old Ross Road (SR 1548) - This two lane facility is an extension of Old Ballpark Road and has a 1997 ADT of 1,000 between Park Street and Whitesides Road. The projected 2010 ADT is estimated to be 1,400. It is recommended to extend Old Ross Road west to US 64/Morganton Road to allow traffic flow in northern Ruth. The expected traffic on this extension in 2010 is 3,300. (Figure 3 - #19)

Old Stonecutter Road (SR 2193) - This route is two lanes between Poors Ford Road and Thunder Road. It has a 1997 ADT of 900 and a projected 2010 ADT from 2,100 to 3,400. This road is to be realigned at the eastern end such that it runs behind the convenience store and ties into Oakland

Road directly opposite of Piney Ridge Road. This road should be extended west to Thunder Road on new location to improve its alignment with Thunder Road due to the proposed US 221 Bypass interchange with Thunder Road. The anticipated 2010 ADT for the western extension is estimated to be 1,300. (Figure 3 - #15, 16)

Park Street (SR 1547) - Park Street is a major thoroughfare from the proposed East-West Connector to Spindale Street at West Street. The traffic will increase significantly in the planning period due to the proposed East-West Connector. The 1997 ADT is 1,400, while the projected 2010 ADT is estimated to be 5,300.

Piney Ridge Road (SR 2159) - Piney Ridge Road from Oakland Road to Butler Road has a 1997 traffic volume of 5,400 and a design year estimated traffic volume of 9,000. Piney Ridge Road from Butler Road to Bethany Road has a 1997 ADT of 4,700 and a 2010 estimated ADT of 6,900. This increase is in part due to its proximity to the Daniel Road Extension and the extension of Old Stonecutter Road which will connect to the western portion of Piney Ridge Road. Although the traffic volumes are increasing significantly, the existing cross section will be adequate for the design year.

Poors Ford Road (SR 1004, SR 2194) - This facility is a two lane major thoroughfare between US 221 and the southern planning area boundary. The 1997 average daily traffic is 4,000 on this portion, while the projected traffic for 2010 is estimated to be 5,600. No improvements are recommended for this portion of Poors Ford Road during the design period.

Thunder Road (SR 2201)- This two lane facility connects the southern planning area to Spindale. Its 1997 ADT ranges from 2,800 to 3,200, and the 2010 volume is estimated to range from 3,000 to 6,000. The increase in the traffic volumes by the design year is due to the proposed interchange between Thunder Road and the proposed US 221 Bypass and due to the extension of Old Stonecutter Road to Thunder Road (intersecting north of the US 221 Bypass interchange). The existing cross section is anticipated to be adequate for the design year of 2010.

West Street (SR 1544) - This route will increase in volume by the design year due to its connection with the proposed East-West Connector. The 1997 estimated ADT from US 74 A to Spindale Street is 3,300, while the design year anticipated volume is estimated to be 10,000. It is recommended that the lanes be widened from 9 foot lanes to 12 foot lanes to provide for safer travel in the design year.

It is recommended to extend West Street to the west from US 74 A to US 221. This will improve Rutherfordton's connectivity to the proposed East-West Connector. The projected 2010 ADT on this extension ranges from 6,200 to 6,700. (Figure 3 - #1)

Minor Thoroughfares

The main purpose of a roadway serving as minor thoroughfare is to collect traffic from local access streets and carry it to the major thoroughfares.

Church Road (SR 1586) - This minor two lane facility between Forest Lake Road and Hudlow Road serves residential development and commercial traffic. The 1997 ADT is 2,400, while the projected 2010 ADT is estimated to be 3,200. The existing facility should be adequate through the design year.

Cleghorn Street - This two lane facility in the downtown area of Rutherfordton connects Charlotte Road/US 74 Business/US 221 A with Green Street. This street is used as a parallel route to Main Street/US 221 for some of the downtown traffic. The 1997 traffic volume is 3,000 vehicles per day, while the projected design year volume is 4,000 vehicles per day. No capacity problems are expected on this facility by the design year, therefore no improvements are recommended for Cleghorn Street.

Duke Street (SR 2184) - This minor thoroughfare is an extension of Daniel Road from US 74 A to US 74 Business/US 221 A. Since improvements are recommended for Daniel Road to connect with Smith Grove Road at US 74 Business/US 221 A, the traffic volumes are expected to decrease on Duke Street, therefore improvements are not recommended over the planning period for Duke Street. The 1997 traffic volume is 5,100. The projected 2010 ADT is estimated to be 2,500.

Edwards Street Extension (SR 1153) - This two lane facility from Bob Hardin Road to Union Road connects to Edwards Street which is a major thoroughfare. It serves mostly residential traffic in the south western portion of the planning area. This facility is not expected to see much increase in traffic by the design year so no improvements are recommended. The 1997 average daily traffic is 500, while the projected 2010 traffic is estimated to be 800.

Hardin Road (SR 2178) - This two lane minor thoroughfare serves residential traffic and the elementary school in the southern portion of Forest City. This street is adequate for future traffic demands and no improvements are recommended during the planning period. The 1997 ADT ranges from 2,100 to 5,800, while the 2010 projected ADT ranges from 4,500 to 8,200.

McDade Road (SR 2214) - This two lane facility serves traffic from Oakland Road to Piney Ridge Road. The 1997 traffic volume is 430 vehicles per day, while the projected 2010 traffic volume is estimated to be 2,400. The existing cross section is adequate for the design period.

Oak Street (SR 2201) Spindale - This minor thoroughfare connects Spindale Street to US 74 Business to US 74 A. The facility is 2 lanes from Spindale Street to US 74 Business and has a 1997 ADT of 2,500 and a 2010 estimated ADT of 3,800. The portion of Oak Street from US 74 Business to US 74 A is a 4 lane facility and has a 1997 ADT of 5,100 and a 2010 projected ADT of 10,500. No improvements are recommended for Oak Street in Spindale during the design period.

Park Street (SR 1547) - Park Street is a two lane minor thoroughfare between Old Ballpark Road and the proposed East-West Connector. The 1997 ADT is 500 to 700. The projected 2010 ADT is estimated to be 800 to 900. No improvements are recommended for the design period.

Pine Street (SR 1903) - This minor thoroughfare in Alexander Mills serves mostly industrial traffic in the south eastern portion of the planning area. It serves as a connector between Mt. Pleasant Church Road to US 221A/Broadway Street. The 1997 traffic volume is 3,600 vehicles, while the projected design year traffic volume is 4,800 vehicles. This two lane street is adequate for future traffic demands.

Poors Ford Road (SR 1004, SR 2194) - Poors Ford Road is a two lane minor thoroughfare between Oakland Road and US 221. The 1997 ADT is 3,800 on this portion, while the 2010 projected ADT is estimated to be 2,000. The decrease in traffic on this portion is in part due to the extension of Oak Street and the proposed US 221 Bypass to move traffic in the southern Spindale area. The existing cross section is adequate for the design period; however, the Poors Ford Road - Old Stonecutter Road intersection needs to be realigned as a part of a larger project aimed at reducing accidents in this area.

Second Street (East) - This two lane facility connects US 221 to Cleghorn Street and to US 74 A in downtown Rutherfordton, serving mostly commercial traffic. The 1997 traffic volume ranges from 1,000 to 2,000. The traffic is not expected to increase significantly in the design period due to the extension of West Street, which will handle some of the east to west downtown traffic. The projected 2010 traffic volume is estimated to range from 2,000 to 3,000. No improvements are recommended for this facility.

Waterworks Road (SR 1537) - Waterworks Road is a two lane minor thoroughfare which connects Old Highway 221 and Rock Road. The 1997 ADT is 2,900 and the 2010 projected ADT is estimated to be 4,700. The existing cross section is adequate for the design period.

Withrow Road (SR 2185) - This two lane route connects Spindale and Forest City. The 1997 ADT of this facility from Oakland Road to US 74 Business/US 221 A is 4,000. The projected 2010 ADT is estimated to be 7,000. This road is adequate for future traffic demands and no improvements are recommended during the planning period.

Chapter 3

Implementation of the Thoroughfare Plan

Once the thoroughfare plan has been developed and adopted, implementation is one of the most important aspects of the transportation plan. Unless implementation is an integral part of this process, the effort and expense associated with developing the plan is lost. There are several tools available for use by the Rutherford County Urban Area to assist in the implementation of the thoroughfare plan. They are described in detail in this Chapter.

State-Municipal Adoption of the Thoroughfare Plan

The Rutherford County Urban Area and the North Carolina Department of Transportation have mutually approved the thoroughfare plan shown in Figure 2. This mutually approved plan serves as a guide for the Department of Transportation in the development of the road and highway system for the Rutherford County Urban Area. The approval of the plan by the Rutherford County Urban Area enables standard road regulations and land use controls to be used effectively in the implementation of this plan. As part of the plan, the Rutherford County Urban Area and Department of Transportation shall reach agreement on the responsibilities for existing and proposed streets and highways. Facilities which are designated as state responsibility will be constructed and maintained by the Division of Highways. Facilities which are designated as municipal responsibility will be constructed and maintained by the municipality.

Subdivision Controls

Subdivision regulations require every subdivider to submit to the appropriate town or county having jurisdiction over the proposed subdivision, a plan of any proposed subdivision. It also requires that subdivisions be constructed to certain standards. Through this process, it is possible to require the subdivision streets to conform to the thoroughfare plan and to reserve or protect necessary right-of-way for projected roads and highways that are to become a part of the thoroughfare plan. The construction of subdivision streets to adequate standards reduces maintenance costs and simplifies the transfer of streets to the State Highway System. Appendix D outlines the recommended subdivision design standards as they pertain to road construction.

Land Use Controls

Land use regulations are an important tool in that they regulate future land development and minimize undesirable development along roads and highways. The land use regulatory system can improve highway safety by requiring sufficient setbacks to provide for adequate sight distances and by requiring off-street parking.

Development Reviews

Development access to a state-maintained street or highway is reviewed by the District Engineer's office and by the Traffic Engineering Branch of the North Carolina Department of Transportation. In addition, any development expected to generate large volumes of traffic (e.g. shopping centers, fast food restaurants, or large industries) may be comprehensively studied by staff from the Traffic Engineering Branch, Planning and Environmental Branch, and/or Roadway Design Unit of

NCDOT. If done at an early stage, it is often possible to significantly improve the development's accessibility while preserving the integrity of the thoroughfare plan.

Funding Sources

Capital Improvements Program

A capital improvement program makes it easier to build a planned thoroughfare system. A capital improvement program consists of two lists of projects. The first is a list of highway projects that are designated as a municipal responsibility and are to be implemented with municipal funds. The second is a list of local projects designated as State responsibility to be included in the Transportation Improvement Program (TIP).

Transportation Improvement Program

North Carolina's Transportation Improvement Program (TIP) is a document which lists all major construction projects the Department of Transportation plans for the next seven years. Similar to local Capital Improvement Program projects, TIP projects are matched with projected funding sources. Every other year, when the TIP is updated, completed projects are removed, programmed projects are advanced, and new projects are added.

During TIP public hearings, municipalities request projects to be included in the TIP. A Board of Transportation member reviews all of the project requests in a particular area of the state. Based on the technical feasibility, need, and available funding, the board member decides which projects will be included in the TIP. In addition to highway construction and widening, TIP funds are available for bridge replacement projects, highway safety projects, public transit projects, railroad projects, and bicycle projects.

Industrial Access Funds

If an industry wishes to develop property that does not have access to a state maintained highway and certain economic conditions are met, then funds may be made available for construction of an access road.

Small Urban Funds

Small Urban Funds are annual discretionary funds made to municipalities with qualifying projects. The maximum amount is $1,000,000 per year per division. A city/town may have multiple projects. Requests for Small Urban Fund assistance should be directed to the appropriate Board of Transportation member and the Division Engineer.

The North Carolina Highway Trust Fund Law

The Highway Trust Fund Law was established in 1989 as a plan with four major goals for North Carolina's roads and highways. These goals are:

1. To complete the remaining 1,716 miles of four lane construction on the 3,600 mile North Carolina Intrastate System.

2. To construct a multilane connector in Asheville and portions of multilane loops in Charlotte, Durham, Greensboro, Raleigh, Wilmington, and Winston-Salem.

3. To supplement the secondary roads appropriation in order to pave, by 1999, 10,000 miles of unpaved secondary roads carrying 50 or more vehicles per day, and all other unpaved secondary roads by 2006.

4. To supplement the Powell Bill Program. The portion of this bill which will benefit the Rutherford County Urban Area, over the thirteen year planning period, is the paving of most, if not all, of its unpaved roads on the State maintained system. Also, there will be an increase in Rutherford County Urban Area Powell Bill Funds if these newly paved roads are in the Rutherford County Urban Area Corporate Limits. For more information on the Highway Trust Fund Law, contact the Program Development Branch of the North Carolina Department of Transportation.

Implementation Recommendations

The following table provides a break down of the projects recommended in the Rutherford County Urban Area Thoroughfare Plan and the corresponding method that would best suit the implementation of the given project.

Table 1

Funding Sources and Methods Recommended for Implementation of Projects

	Funding Sources				Methods of Implementation			
Projects	Local Funds	TIP Funds	Indust. Access	Small Urban	T-fare Plan	Subdiv. Ord.	Zoning Ord.	Development Review
East-West Connector		X			X		X	X
West Street Extension		X			X	X		X
US 221 Bypass		X			X		X	X
US 221 Improvements		X			X			X
US 221 A Improvements		X			X			X
US 74 A Extension		X			X		X	X
Oak Street Extension		X			X	X		X
Oak Street Improvements		X			X	X		X

Construction Priorities and Cost Estimates

Construction priorities will vary depending on what criteria are considered and what weight is attached to the various criteria. Most people would agree that improvements to the major thoroughfare system and major traffic routes would be more important than minor thoroughfares where traffic volumes are lower. To be in the North Carolina Transportation Improvement Program, a project must show favorable benefits relative to costs and should not be prohibitively disruptive to the environment. The potential cost estimate of Rutherford County Urban Area projects with respect to the user benefits, and the probabilities that economic development will be stimulated and environmental impact will be minimized are given in Table 3. A guide to this table is shown in Table 2.

Table 2

Probability Estimation Guide

Subjective Evaluation	Impact Probability
Excellent - very substantial	1.00
Very good - substantial	0.75
Good - considerable	0.50
Fair - some	0.25
Poor - none	0.00

Reduced road user cost should result from any roadway improvement, from a simple widening to the construction of a new roadway. Roadway improvements should also relieve congested or unsafe conditions. Comparisons of the existing and the proposed facilities have been made in terms of vehicle operating costs, travel time costs, and accident costs. These user benefits are computed as total dollar saving over the 13 year design period using data such as project length, base year and design year traffic volumes, traffic speed, type of facility, and volume capacity ratio.

The impact of a project on economic development potential is shown as the probability that it will stimulate the economic development of an area by providing access to developable land and reducing transportation costs. It is a subjective estimate based on the knowledge of the proposed project, local development characteristics, and land development potential. The probability is rated on a scale from 0 (representing no development potential) to 1.00 (representing excellent development potential).

The environmental impact analysis considers the effect of a project on the physical, social/cultural, and economic environment. Below are listed the thirteen items that are considered when evaluating the impacts on the environment

* air quality
* water resources
* soils and geology
* wildlife
* vegetation
* neighborhoods noise
* noise
* educational facilities
* churches
* parks and recreational facilities
* historic sites and landmarks
* public health and safety
* aesthetics

The environmental impact analysis also uses a probability rating from 0 (representing no benefit to the environment) to 1.00 (representing a positive impact to the environment.) A negative value is assigned to the probability to indicate a negative impact. The summation of both positive and negative impacts probabilities with respect to these factors provides a measure of the relative environmental impacts of a project. Table 2 shows the probability scale used in the analysis. This table can be used as a guideline for interpreting the "Economic Development" and Environmental Impact" values given in Table 3.

Table 3

Benefits Evaluation for Major Projects

Projects	Benefits (millions)	Costs (millions)	Length miles	Benefits/ mile (millions)	Economic Development	Envirn. Impact
East-West Connector	$24.4	$10.0	7.06	$3.5	+0.10	-0.20
US 221 Bypass	$40.3	$44.0	7.52	$5.4	+0.10	-0.20
US 74 A Extension	$16.2	$5.5	1.41	$11.5	+0.10	-0.20
Oak Street Ext. - West	$12.4	$4.7	2.35	$5.3	+0.10	-0.20

Offsetting the benefits that would be derived from any project is the cost of its construction. A new facility, despite its high projected benefits, might prove to be unjustified due to the excessive costs involved in construction. The highway costs estimated in this report are based on the average statewide construction costs for similar project types. The anticipated right-of-way costs is also included as an average cost per acre for property throughout the Rutherford County Urban Area according to the respective project. Table 4 provides a break down of total project cost into construction cost and right-of-way cost for the major project proposals for the Thoroughfare Plan.

Table 4

Potential Project Cost Estimates for Major Projects (in millions)

Project Description	Construction Cost	Right-of-way Cost	Total Cost
East-West Connector	$8.0	$2.0	$10.0
US 221 Bypass	$41.5	$2.5	$44.0
US 74 A Extension	$4.9	$0.6	$5.5
Oak Street Extension - West	$4.0	$0.7	$4.7

Chapter 4

Analysis Rutherford County Urban Area's Roadway System

This chapter presents an analysis of the ability of the existing street system to serve the area's travel desires. Emphasis is placed not only on detecting the deficiencies, but on understanding their cause. Travel deficiencies may be localized and the result of substandard highway design, inadequate pavement width, or intersection controls. Alternately, the underlying problem may be caused by a system deficiency such as a need for a bypass, loop facility, construction of missing links, or additional radials.

Existing Travel Patterns

An analysis of the roadway system must first look at existing travel patterns and identify existing deficiencies. This includes roadway capacity and safety analysis. Also in an urban area, a street's ability to move traffic is generally controlled by the spacing of major intersections, access control, width of pavement, and the traffic control devices (such as signals) utilized.

After the existing picture of travel in the area has been developed, the engineer must analyze factors that will impact the future system. These factors include forecasted population growth, economic development potential, and land use trends. This information will be used to determine future deficiencies in the transportation system.

Capacity Analysis of the Existing System

An indication of the adequacy of the existing street system is a comparison of traffic volumes versus the ability of the streets to move traffic freely at a desirable speed. The ability of a street to move traffic freely, safely, and efficiently with a minimum delay is controlled primarily by the spacing of major devices utilized. Thus, the ability of a street to move traffic can be increased by restricting parking and turning movements, using proper sign and signal devices, and by the application of other traffic engineering strategies.

Capacity is the maximum number of vehicles which has a "reasonable expectation" of passing over a given section of a roadway, during a given time period under prevailing roadway and traffic conditions. The relationship of traffic volumes to the capacity of the roadway will determine the level of service (LOS) being provided. Six levels of service have been selected for analysis purposes. They are given letter designations from A to F with LOS A representing the best operating conditions and LOS F the worst.

The six levels of service are illustrated in Figure 4, and they are defined on the following pages. The definitions are general and conceptual in nature, but may be applied to urban arterial levels of service. Levels of service for interrupted flow facilities vary widely in terms of both the user's perception of service quality and the operational variables used to describe them. The 1995 Highway Capacity Manual contains more detailed descriptions of the levels of service as defined for each facility type.

Level of Service

LOS A

Describes primarily free flow conditions. The motorist experiences a high level of physical and psychological comfort. The effects of minor incidents of breakdown are easily absorbed. Even at the maximum density, the average spacing between vehicles is about 528 ft, or 26 car lengths.

LOS B

Represents reasonably free flow conditions. The ability to maneuver within the traffic stream is only slightly restricted. The lowest average spacing between vehicles is about 330 ft, or 18 car lengths.

LOS C

Provides for stable operations, but flows approach the range in which small increases will cause substantial deterioration in service. Freedom to maneuver is noticeably restricted. Minor incidents may still be absorbed, but the local decline in service will be great. Queues may be expected to form behind any significant blockage. Minimum average spacings are in the range of 220 ft, or 11 car lengths.

LOS D

Borders on unstable flow. Density begins to deteriorate somewhat more quickly with increasing flow. Small increases in flow can cause substantial deterioration in service. Freedom to maneuver is severely limited, and the driver experiences drastically reduced comfort levels. Minor incidents can be expected to create substantial queuing. At the limit, vehicles are spaced at about 165 ft, or nine car lengths.

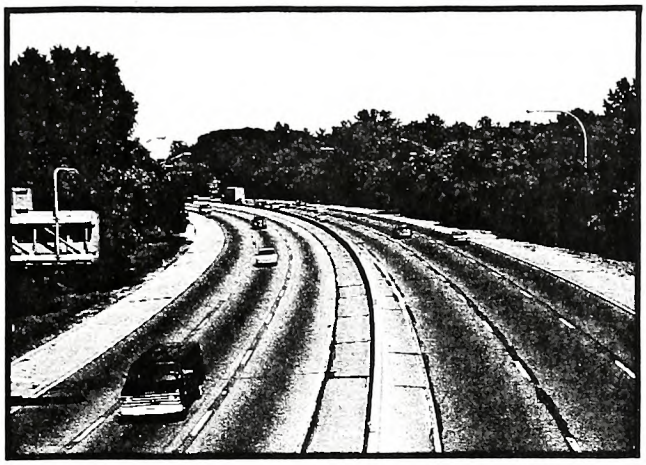
LOS E

Describes operation at capacity. Operations at this level are extremely unstable, because there are virtually no usable gaps in the traffic stream. Any disruption to the traffic stream, such as a vehicle entering from a ramp, or changing lanes, requires the following vehicles to give way to admit the vehicle. This can establish a disruption wave that propagates through the upstream traffic flow. At capacity, the traffic stream has no ability to dissipate any disruption. Any incident can be expected to produce a serious breakdown with extensive queuing. Vehicles are spaced at approximately six car lengths, leaving little room to maneuver.

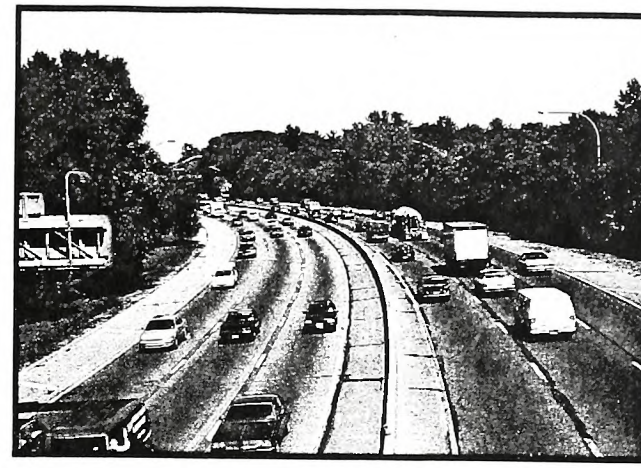
LOS F

Describes forced or breakdown flow. Such conditions generally exist within queues forming behind breakdown points.

Source: 1994 Highway Capacity Manual



LOS A.



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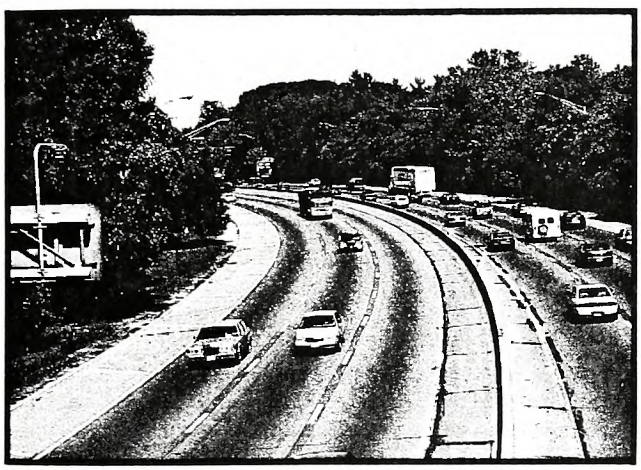

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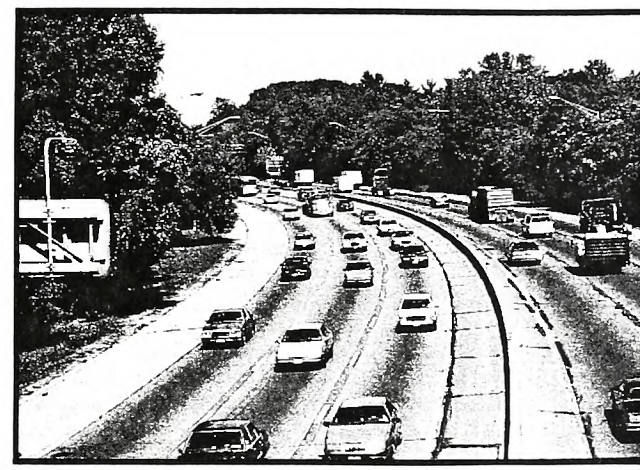

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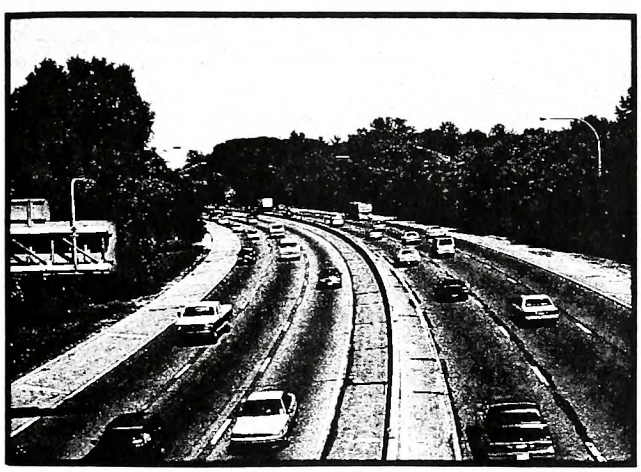
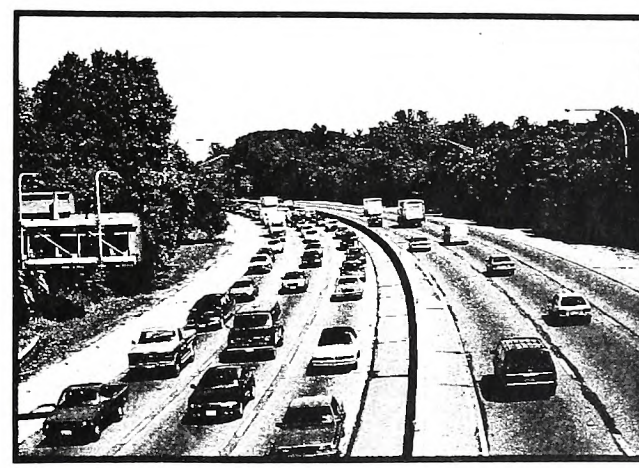


LOS C.



LOS F.

FIGURE 4

LEVELS OF SERVICE

Traffic Accidents

Traffic accident are often used as an indicator for locating congestion problems. Traffic accident records can also be reviewed to identify problem locations or deficiencies such as poor design, inadequate signing, ineffective parking, or poor sight distance. Accident patterns developed from analysis of accident data can lead to improvements that will reduce the number of accidents.

Table 5 is a summary of the accidents occurring in the Rutherford County Urban Area from 1996 to 1998. This table only includes locations with 10 or more accidents. The "Number of Crashes" column indicates the total number of accidents reported within 200 ft (61.0 m) of the intersection during the study period indicated. The severity index listed is the average accident severity for that location.

Table 5
Locations with 10 or More Accidents in a 3-Year Period in Rutherford County
(1/1/96 - 12/31/98)

				Equivalent	Crash
	Intersection	of	Number of	Property Damage	Severity
Municipality	Road A	Road B	Crashes	Only Index	Index
RUTHERFORDTON	US 74 A	US 74 B	36	178.4	4.96
FOREST CITY	US 74 A	Oak St. (SR2179)	24	469.6	19.57
RURAL-RUTHERFORD	Doggett Rd. (SR2159)	S. Church St. (SR2213)	19	215	11.32
FOREST CITY	Main St.	Withrow Rd. (SR2185)	18	106.8	5.93
FOREST CITY	Main St.	Powell St.	16	38.2	2.39
FOREST CITY	Commercial	Oak St. (SR2179)	15	272	18.13
FOREST CITY	Broadway St.	Well St.	15	120.4	8.03
RURAL-RUTHERFORD	US 221	Poors Ford Rd. (SR2194)	14	126.8	9.06
RURAL-RUTHERFORD	US 221	Poors Ford Rd. (SR1004)	14	80.6	5.76
ALEXANDER MILLS	US 221A	Pine St. (SR 1903)	14	58.4	4.17
ALEXANDER MILLS	US 74	US 221A	13	57.4	4.42
FOREST CITY	Hardin Rd. (SR 2178)	Westview St.	12	139.6	11.63
FOREST CITY	Cherry Mountain	Trade St.	12	110	9.17
FOREST CITY	US 74 A	Daniel Rd.	12	56.4	4.70
FOREST CITY	Broadway St.	Florence	12	56.4	4.70
FOREST CITY	Broadway St.	Main St.	12	49	4.08
FOREST CITY	Hardin Rd. (SR 2178)	Oak St. (SR2179)	12	49	4.08
RUTHERFORDTON	US 74 B	US 74 B	11	138.6	12.60
RUTHERFORDTON	US 74 B	Cleghorn Street	11	48	4.36
RUTHERFORDTON	Court St.	Washington St.	10	10	1.00

Both the severity index and number of accidents should be considered when investigating accident data. The severity of every accident is measured with a series of weighting factors developed by NCDOT's Division of Highways. In terms of these factors, a fatal or incapacitating accident is 47.7 times more severe than one involving only property damage, and an accident resulting in minor injury is 11.8 times more severe than one with only property damage. To request a more detailed accident analysis for any of the above mentioned intersections, or other intersection of concern, the County should contact the Division 13 Traffic Engineer.

1997 Traffic Capacity Analysis

Capacity Deficiencies - Figure 5 depicts the base year (1997) major street system, and the volume to capacity ratios. A comparison of the base year ADT to capacities (volume to capacity ratio) reveals that sections of the following major thoroughfares are near or over their practical capacity (LOS D). These areas are highlighted, and include:

US 64 - From Old Highway 221 to US 74 A/Railroad Avenue, US 64 is currently near capacity. The capacity for this section is 11,000 vpd (vehicles per day). Currently, approximately 10,000 vpd are using this section. By the year 2010, if no improvements are made to the existing system, this volume is expected to increase to 18,400 vpd in this section.

US 74 A/Railroad Avenue - From US 64/Morganton Road to US 74 Business, US 74 A/Railroad Avenue is currently exceeding capacity. It has a capacity of 11,000 vpd. Currently, 16,500 vpd are using this section and by 2010, there it is expected that there will be 24,000 vpd on this facility if no improvements are made to the present street network. It is recommended to widen the section of US 74 A from Whitesides Road to US 74 Business.

US 74 A - From Thunder Road to US 74, US 74 A is approaching capacity in 1997. If no improvements are made to the existing street network, in 2010 (the design year), US 74 A will exceed capacity.

US 74 Business - This facility from just east of US 74 A/Railroad Avenue to Bostic Road is exceeding capacity; however, most of this facility's corridor is heavily developed and the impact of any major widening will be tremendous. Parking could be improved or redesigned in some areas to provide more lane width and improve the traffic flow in the area. Several improvements outside of removing parking and completely widening this facility are recommended in Chapter 2. The project providing the most extensive relief is the East-West Connector.

US 221 A - From US 74 Business to the southern planning area boundary, US 221 A is currently approaching capacity. There are currently approximately 13,000 vpd on this facility and if no improvements are made to the planning area's street network, there will be 19,000 by the year 2010. The US 74 A extension should help alleviate some congestion, since it will provide another route in Alexander Mills.

Oak Street - From US 74 A to Hardin Road, Oak Street is currently meeting capacity and has 11,000 vpd. By the year 2010 this section would have 16,000 vpd if no improvements are made. Oak Street has been recommended for extension and this would help alleviate some congestion.

South Church Street - From US 74 A to north of Doggett Road, this facility has a capacity if 9,000. This section currently is near capacity and has 10,300 vpd. If no improvements are implemented, by 2010, 14,600 vpd will be using this facility. The Oak Street Extension to Broadway Street and Old Caroleen Road will improve the traffic flow in Forest City such that Church Street will not need additional improvements. South Church Street is recommended to connect to North Church Street and North Church Street to connect to Old Bostic Road with a small extension at Luckadoo Street. This improved facility will provide for a north-south route from Bostic to US 74 A.

1997

CAPACITY – DEFICIENCIES
BASE YEAR STREET SYSTEM AND BASE YEAR ADT'S COMPARED WITH THE CAPACITY

LEGEND FOR $\frac{V}{C}$ RATIOS

0.8 – 1.1

> 1.1

$\frac{V}{C} = \frac{\text{traffic volume}}{\text{roadway capacity}}$

FIGURE 5

RUTHERFORD COUNTY
URBAN AREA

RUTHERFORD COUNTY

NORTH CAROLINA

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS – STATEWIDE PLANNING BRANCH
IN COOPERATION WITH THE
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0 2000 4000 6000 8000
feet

0 1000 2000 3000
kilometers

2010

CAPACITY – DEFICIENCIES EXISTING STREET SYSTEM WITH 2010 ADT

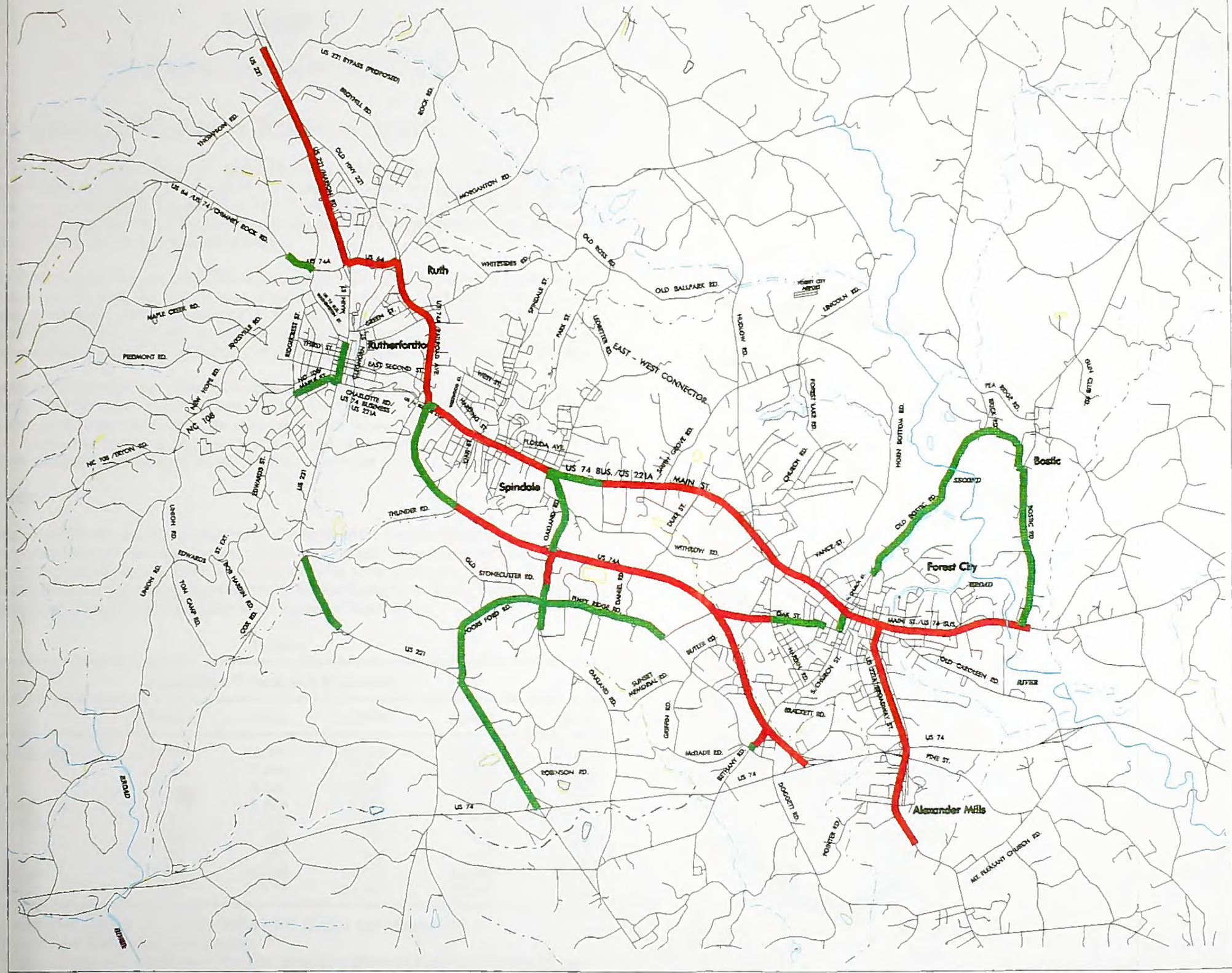
LEGEND FOR $\frac{V}{C}$ RATIOS

0.8 – 1.1

> 1.1

$\frac{V}{C} = \frac{\text{traffic volume}}{\text{roadway capacity}}$

FIGURE 6



N

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RUTHERFORD COUNTY

URBAN AREA

RUTHERFORD COUNTY

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0 2000 4000 6000 8000
feet

0 1000 2000 3000
kilometers

Chapter 5

Population, Land Use, and Traffic

Factors Affecting the Future Roadway System

The objective of thoroughfare planning is to develop a transportation system that will meet future travel demand and enable people and goods to travel safely and economically. To determine the needs of an area it is important to understand the role that population, economics, and land use have on the highway system. Examination of these factors helps to explain historic travel patterns and lays the groundwork for thoroughfare planning.

In order to formulate an adequate year 2010 thoroughfare plan, reliable forecasts of future travel characteristics must be achieved. The factors of population, vehicle usage trends, economy and land use play a significant role in determining the transportation needs of the area, and must be carefully analyzed. Additional items may include the effects of legal controls such as subdivision regulations and zoning ordinances, availability of public utilities and physical features of the area.

The first step in the development of the thoroughfare plan is to define the planning period and the planning area. The base year for the Rutherford County Urban Area study was 1997, and the year 2010 was chosen to be the end point of the study period (13 years). The planning area is generally the limits to which urbanization is expected to occur during the planning period. The planning area is then subdivided into traffic analysis zones. Figure 7 shows the planning area boundary and zones.

Population

The amount of traffic on a section of roadway is a function of the size and location of the population which it serves. Investigating past trends in population growth and forecasting future population growth and dispersion is one of the first steps for a transportation planner. Table 6 shows the historical and projected population trends for the Rutherford County Urban Area through 2010. A graphical illustration of the population is shown in Figure 8.

Table 6

Population Trends and Projections

Place/Year	1970a	1980a	1990a	2000b	2010b
Rutherford County	47,337	53,787	56,918	60,261	62,472
Forest City	7,179	7,688	7,475	7,268	7,067
Spindale	3,848	4,246	4,040	3,842	3,655
Rutherfordton	3,245	3,434	3,617	3,810	4,012
Alexander Mills	988	643	662	709	744
Bostic	289	476	371	412	455
Ruth	360	381	366	459	507
Total for towns	15,918	16,868	16,531	16,500	16,440
Planning Area	*****	*****	25,000	26,247	27,164

a/U.S. Bureau of Census, N.C. State Office State Budget and Management
b/ Office of State Budget and Management
*****Planning area boundaries have changed; therefore, previous planning areas are not an indicator of historical trends

The most important population estimate for development of the thoroughfare plan is that of the planning area. Population projections are shown in Table 7.

Table 7

Rutherford County Urban Area Population Forecasts

Year	Population
1990	25,000
2000	26,247
2010	27,164

Economy and Employment

One of the more important factors to be considered in estimating the future traffic growth of an area is its economic base. The number of employers and the employee's income or purchasing power influences how much population can be supported in the area and the number of motor vehicles that will be locally owned and operated. Generally, as the family income increases so does the number of vehicles owned, as well as the number of vehicle trips generated per day by each household. An accurate projection of the future economy of the area is essential to estimating future travel demand.

A factor which will influence economic growth and development in Rutherford County over the 13 year planning period is the expected high growth for employment just west of Rutherfordton's CBD in the Rutherford County Urban Planning Area. Some additional textile manufacturing employment is expected there. Medium to low employment growth is expected in Spindale, primarily along US 74 Business and US 74 A but also on Oak Street, Oakland Road, Withrow Road, and Duke Street. The working population of Rutherford County is mainly a mixture of industrial, retail, and service industries. These three types of employment, employ over 83% of the working population of Rutherford County. Table 8 Employment Stratification for Rutherford County was developed using the sum of the estimated jobs of each employer for 1997.

Table 8

Employment Stratification for Rutherford County Urban Area

Type of Employment	Employment 1997	% of Total 1997	Employment 2010	% of Total 2010
Industrial	8918	56.5%	10061	51.3%
Retail	1523	9.7%	2182	11.1%
Highway Retail	1163	7.4%	2574	13.1%
Office	1506	9.5%	1798	9.2%
Service	2661	16.9%	2974	15.3%
Total	15771	100.0%	19589	100.0%

Land Use

Land use refers to the physical patterns of activities and functions within a city or county. Nearly all traffic problems in a given area can be attributed in some form to the type of land use. For example, a large industrial plant might be the cause of congestion during shift change hours as its workers come and go. However, during the remainder of the day few problems, if any, may occur. The spatial distribution of different types of land use is the predominant determinant of when, where, and why congestion occurs. The attraction between different land uses and their association with travel varies depending on the size, type, intensity, and spatial separation of each.

For use in transportation planning, land uses are grouped into four categories:

1. Residential - all land devoted to the housing of people (excludes hotels and motels)

2. Commercial - all land devoted to retail trade including consumer and business service and office

3. Industrial - all land devoted to manufacturing, storage, warehousing, and transportation of products

4. Public - all land devoted to social, religious, educational, cultural, and political activities.

Figure 9 shows the planning area's existing land use. Figure 10 shows the planning area's future land use (2010).

Anticipated future land use is a logical extension of the present spatial distribution. Determination of where expected growth is to occur within the planning area facilitates the location of proposed thoroughfares or the improvements of existing thoroughfares. Areas of anticipated development and growth for the Rutherford County Urban Area are:

1. Residential - A large amount of Rutherford County's residential land development surrounds the CBDs of Rutherfordton, Spindale, and Forest City although housing can be found almost everywhere. New developments are being built south and west of Rutherfordton and north of Ruth. The potential for new residential development is expected to be high south of Rutherfordton along US 221, around Edwards Street, Edwards Street Extension, Union Road, and Tom Camp Road. Medium growth is predicted north of Rutherfordton near Thompson Road, Westbrook Drive, US 64, US 221 and Old Highway 221. Primarily medium growth, but some high, is predicted in the vicinity of Forest Lake, Church, Hudlow, and Smith Grove Roads northwest of Forest City. South of Piney Ridge Road and US 74 A from Poors Ford Road to Alexander Mills, medium residential growth is expected with some high growth extending up South Church Street in Forest City. Low residential growth with some medium pockets is then predicted for the most part across the remainder of the planning area except where heavy industry exists, in areas already "built-out", and on the Isothermal Community College campus.

2. Commercial/Retail - Most of the commercial development in the Rutherford County Urban Area is near the CBDs and along major thoroughfares such as US 74 Business, US 74 A, US 221, Oak Street in Forest City and Spindale, Broadway Street, and in the vicinity of Withrow and Callahan Koon Roads. Medium commercial growth is expected along US 221 south of Rutherfordton. Medium commercial is also expected north of Rutherfordton and Bostic.

3. Industrial - The industrial development in the Rutherford County Urban Area is located along major thoroughfares such as US 74 Business, US 74 A, US 221, Oak Street in Forest City and Spindale, Broadway Street, and in the vicinity of Withrow and Callahan Koon Roads. While some industrial plants are clustered together, many are interspersed across the planning area, often in close vicinity to neighborhoods. This heavy manufacturing base requires extensive goods movement. Trucking prevails over rail use in the area. Not many roads are spared the truck traffic, even residential streets. Medium industrial growth is expected along US 221 south of Rutherfordton. Medium industrial growth is also predicted east and west of Alexander Mills. Medium manufacturing growth may occur west of Bostic near the rail lines.

4. Public - The Rutherford County Urban Area has several public areas within the planning area. See Figure 9 (1989 Land Use) for the locations of public areas.

Low growth is expected in the vicinity of Ruth along Railroad Avenue and US 64. Low growth is also predicted north of Forest City.

Future Travel Demand

Travel demand is generally reported in average daily traffic counts. Traffic counts are taken regularly in and around the Rutherford County Urban Area by the North Carolina Department of Transportation. A comparison of annual growth rates from 1970 to 1989 at various count locations in the Rutherford County Urban Area show the average annual growth rate ranges from 2% to 4%. The largest growth was noted on US 74 A, US 221, US 74 Business, US 74, Oak Street, and US 221 A/Broadway Street. Figures 5 and 6 show the volume to capacity ratios for 1997 and 2010, respectively. These figures depict the facilities that increased travel demand will effect the most. To estimate the future travel demand, a transportation model was developed for the Rutherford County Urban Area. The base year data collected for this model was for 1989. Due to circumstances beyond our control, the study base year was changed to 1997. In 1997, we began utilizing the data previously collected for 1989 and the growth rates projected for 2010 to project the 1989 data to the new base year of 1997. The new base year model was developed and calibrated based on this data. The design year (2010) data, projected from the 1989 data was utilized for our design year model. Please see Chapter 7 (Traffic Model Development) for further information on the development of the base year and design year models.

RUTHERFORD COUNTY URBAN AREA ZONE MAP

LEGEND

CORDON LINE

SCREEN LINE

ZONE LINE

FIGURE 7

JULY 31, 1997

RUTHERFORD COUNTY URBAN AREA

RUTHERFORD COUNTY

NORTH CAROLINA

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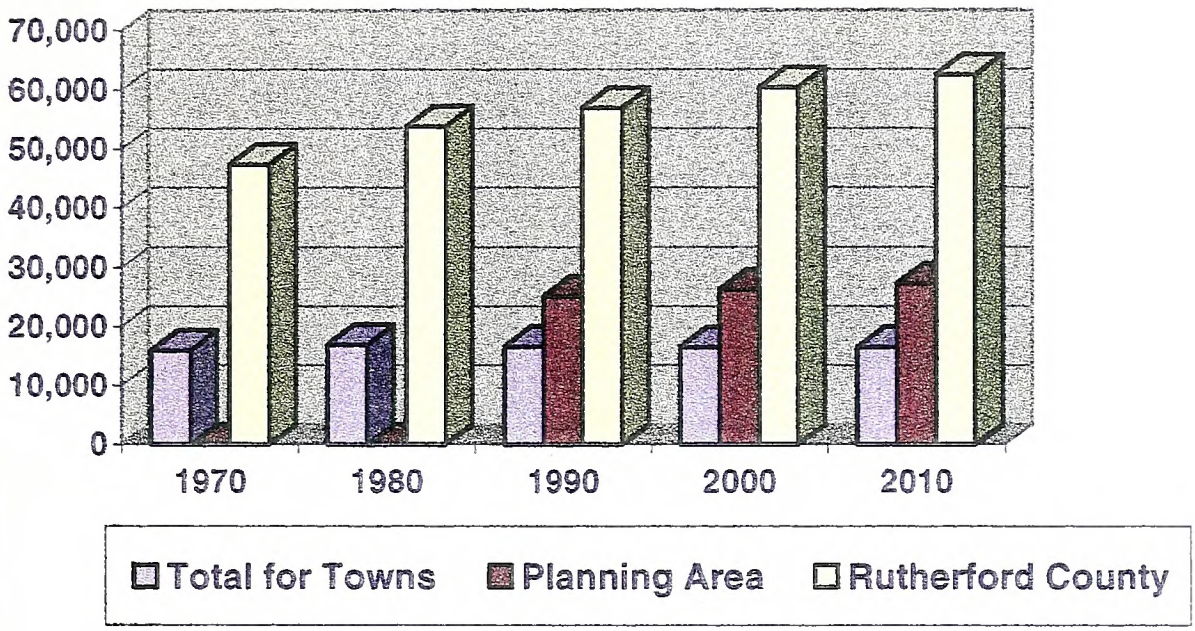
FEDERAL HIGHWAY ADMINISTRATION

0 2000 4000 6000 8000
feet

0 1000 2000 3000
kilometers

Figure 8

Rutherford County Urban Area
Population Projections



*** Planning area boundaries have changed; therefore, 1970 and 1980 planning area populations are not shown.

1989
LANDUSE MAP

RESIDENTIAL

COMMERCIAL

INDUSTRIAL

PUBLIC/INSTITUTIONAL

FIGURE 9

July 27, 1995

N

S

RUTHERFORD COUNTY
URBAN AREA

RUTHERFORD COUNTY

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0 2000 4000 6000 8000
feet

0 1000 2000 3000
kilometers

2010
LANDUSE MAP

RESIDENTIAL

COMMERCIAL

INDUSTRIAL

PUBLIC/INSTITUTIONAL

FIGURE 10

July 27, 1995

N

S

RUTHERFORD COUNTY
URBAN AREA

RUTHERFORD COUNTY

NORTH CAROLINA

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0 2000 4000 6000 8000
feet

0 1000 2000 3000
kilometers

Chapter 6

Environmental Concerns

In the past several years, environmental considerations associated with highway construction have come to the forefront of the planning process. The legislation that dictates the necessary procedures regarding environmental impacts is the National Environmental Policy Act. Section 102 of this act requires the execution of an environmental impact statement, or EIS, for road projects that have a significant impact on the environment. Included in an EIS would be the project's impact on wetlands, water quality, historic properties, wildlife, and public lands. While this report does not cover the environmental concerns in as much detail as an EIS, preliminary research was done on several of these factors and is included below.

Wetlands

In general terms, wetlands are lands where saturation with water is the dominant factor in determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. The single feature that most wetlands share is soil or substrata that is at least periodically saturated with or covered by water. Water creates severe physiological problems for all plants and animals except those that are adapted for life in it or in saturated soil.

Wetlands are crucial ecosystems in our environment. They help regulate and maintain the hydrology of our rivers, lakes, and streams by slowly storing and releasing flood waters. They help maintain the quality of our water by storing nutrients, reducing sediment loads, and reducing erosion. They are also critical to fish and wildlife populations. Wetlands provide an important habitat for about one third of the plant and animal species that are federally listed as threatened or endangered.

In this study, the impacts to wetlands were determined using the National Wetlands Inventory Mapping, available from the U. S. Fish and Wildlife Service. The location of wetlands throughout the Rutherford County Urban Area are shown in Figure 11.

Wetland impacts have been avoided or minimized to the greatest extent possible while preserving the integrity of the transportation plan.

Threatened and Endangered Species

A preliminary review of the Federally Listed Threatened and Endangered Species within Rutherford County's Planning Area was done to determine the effects that new corridors could have on the wildlife. These species were identified using mapping from the North Carolina Department of Environment, Health, and Natural Resources.

The Threatened and Endangered Species Act of 1973 allows the U. S. Fish and Wildlife Service to impose measures on the Department of Transportation to mitigate the environmental impacts of a road project on endangered plants and animals and critical wildlife habitats. By locating rare species in the planning stage of road construction, we are able to avoid or minimize these impacts.

There were no apparent threatened or endangered species identified in the Rutherford County Planning Area; however, a detailed field investigation is recommended prior to construction of any highway project in this area.

There were no other species identified in the Rutherford County Urban Planning Area that are significantly rare or are of special concerns in North Carolina.

Historic Sites

The location of historic sites in the Rutherford County Urban Area was investigated to determine the possible impacts of the various projects studied. The federal government has issued guidelines requiring all State Transportation Departments to make special efforts to preserve historic sites. In addition, the State of North Carolina has issued its own guidelines for the preservation of historic sites. These two pieces of legislation are described below:

National Historic Preservation Act - Section 106 of this act requires the Department of Transportation to identify historic properties listed in the National Register of Historic Places and properties eligible to be listed. The DOT must consider the impacts of its road projects on these properties and consult with the Federal Advisory Council on Historic Preservation.

NC General Statute 121-12(a) - This statute requires the DOT to identify historic properties listed on the National Register, but not necessarily those eligible to be listed. DOT must consider impacts and consult with the North Carolina Historical Commission, but it is not bound by their recommendations.

There is currently one property in the Rutherford County Urban Planning Area that is listed on the National Register of Historic Places. The following is a list of Historic Places reported by the Rutherford County Historical Society in the Rutherford County Urban Planning Area and their locations are shown in Figure 11.

Historic Places

1. The Bechtler Mint was the only privately owned and operated mint to ever mint coins accepted as legal tender by the United States. It minted gold coins from 1831-1840 and was the first to mint a gold dollar. In April, 1997, this site was included on the national historic register. It is located on the east side of Gilboa Church Road (SR 1532), approximately 300 yards north of the intersection of Gilmer Edwards Road (SR 1526). The mine shaft entrance and the site of the Bechtler house and shop are approximately 100 yards east of Gilboa Church Road.

2. The Gilbert Town Site is located on both sides of Rock Road (SR 1520) approximately 250 yards north of the intersection of Gilbert Town Road (SR 1539).

3. The Overmountain Victory National Historic Trail follows the route of the Patriot troops which defeated the Loyalist troops, commanded by Major Ferguson, at Kings Mountain during the Revolutionary War. This trail is walked annually by reenactors who are joined by local citizens and school children. This trail is administered by the National Parks Service and the volunteer Overmountain Victory Trail Association. Portions of the trail follow US 64.

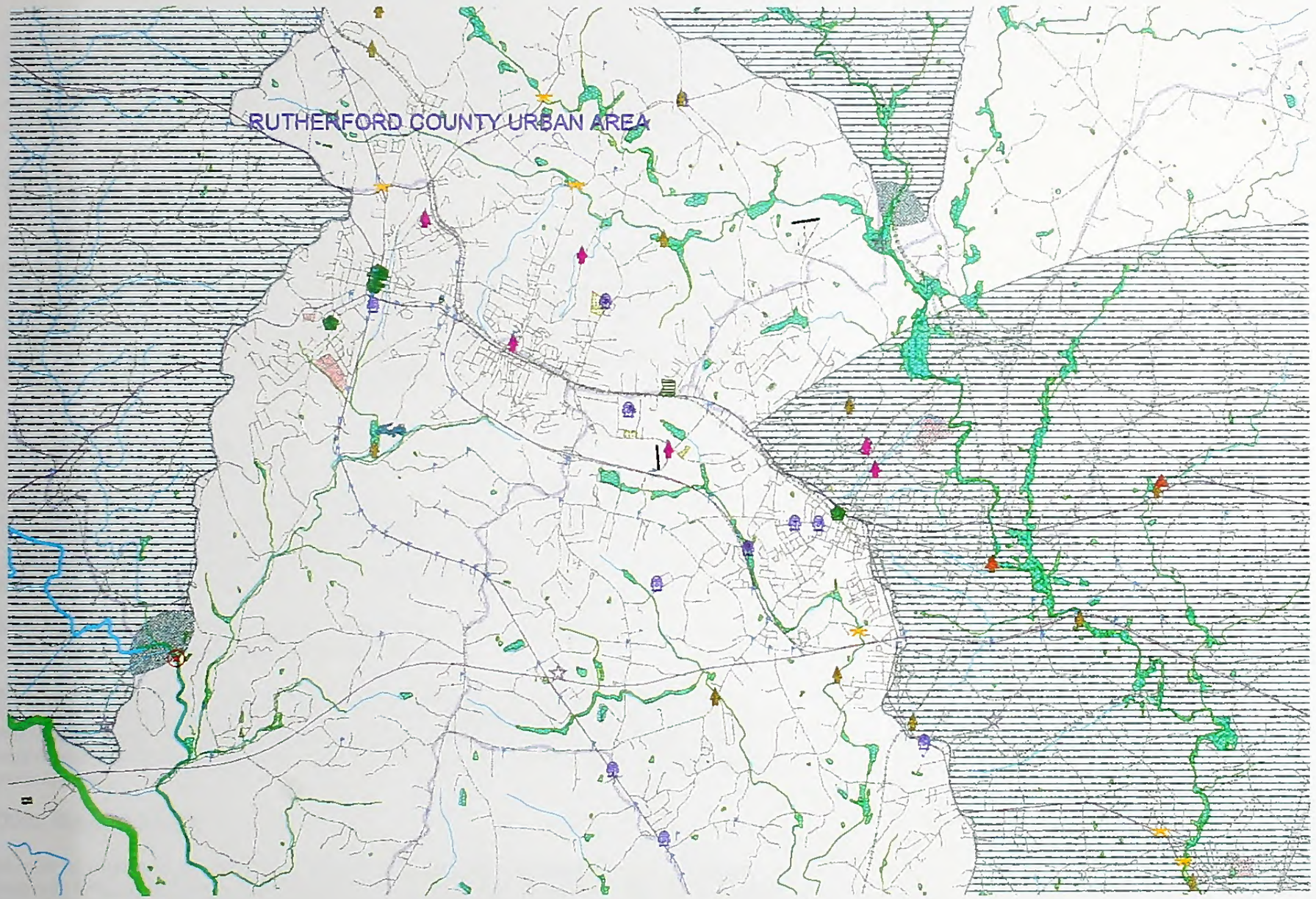
4. The William Gilbert House, located on the above mentioned trail, is the only remaining structure of the pre-Revolutionary village of Gilbert Town. The William Gilbert House stands on the west side of Rock Road (SR 1520), approximately 250 yards north of the intersection of Gilbert Town Road (SR 1539), being the first house north of this intersection. It is at the foot of a hill where both Patriot and Loyalist troops camped. The Overmountain Victory Trail Association uses it as a focal point of their annual walk.

None of these properties should be affected by the projects proposed on the thoroughfare plan. However, care should be taken to make certain that all historic sites and natural settings are preserved. Therefore, a closer study should be done in regard to the local historic sites prior to the construction of any proposal.

Archaeology

There are no archaeology sites found to be of significance in the Rutherford County Urban Planning Area; however, care should be taken to make sure that any possible archaeological sites should be looked at closer prior to the construction of any proposals.

Environmental Data for the Rutherford County Urban Area



3 0 3 6 Miles

LEGEND

- Geodetic Control Points (24k)
- Ambient Water Quality Monitoring Sites (100k)
- Citizen Water Quality Monitoring Sites (100k)
- NPDES - Non Discharge Systems (100k)
- NPDES - Point Source Dischargers (24k)
- Surface Water Intakes (100k)
- Groundwater Incidents (100k)
- Nat. Heritage Occurence Sites (Restricted-100k)
- Hist. Struct.-NR (Restricted-100k)
- Hist. Dist. -NR (Restricted-100k)
- Hist. Struct.-SL(Restricted-100k)
- Hist. Dist.-SL(Restricted-100k)
- Solid Waste Facilities (24k)
- Hazardous Waste Facilities (Unverified 24k)
- Superfund Pts. (Haz. Subs. Dispos. Sites)
- Superfund Areas (Haz. Subs. Dispos. Sites)
- Marinas (points-24k)
- Railroads (100k)
- TIP Bridges (point- 24k)
- National Highway System Roads (100k TIGER w/ attributes)

Airports / Substations
- Airport
- Power Substation
- Prop. Critical Habitat Areas (1 mile buffer-24k)
- Trout Streams (WRC - 100k)
- Trout Streams (DWQ - 100k)
- Anadromous Fish Spawning Areas (100k)
- Fish Nursery Areas (24k)

DCM Wetlands
- High Quality Wetlands
- Pocosin (High)
- Medium Quality Wetlands
- Low Quality Wetlands
- NWI (arc-24k)
- NWI (poly-24k)
- Hydro - Rivers/Streams (100k)
- Hydro -Water Bodies (100k)
- Hydro - Major Rivers/Streams (100k)
- Hydro - Major Water Bodies (100k)
- HQW Zones (100k)
- Groundwater Recharge/Discharge Areas (100k)

Water Supply Watersheds (24k)
- Critical
- Protected
- Natural Areas (Restricted-24k)
- Gamelands (100k)
- Land & Water Consv. Fund (100k)
- State Parks (100k)
- State Owned Complexes (100k)
- Federally Owned Lands (100k)
- River Basins - Minor (24k)
- Hydrologic Units (24k)

N W E S

Chapter 7

Traffic Model Development

In order to develop an efficient thoroughfare plan for the Rutherford County Urban Area it was necessary to develop and calibrate a traffic model of the Rutherford County Urban Area. To develop a traffic model the following are necessary: define the study area and project socioeconomic data to the design year. Once the socioeconomic data has been projected, the model may be used to evaluate various street system problems and alternate solutions to the problems.

The Study Area

The study area of Rutherford County Urban Area consists of the county and some additional outlying areas (Figure 7). This area was divided into 114 zones for data collection and aggregation. These zones reflect similar land use throughout the planning area. The data for the dwelling units and employment for 1997 was collected from census data and 1989 land use data. The projection of socioeconomic data to the future year (2010) was done based on past trends from previous census data and projections by the Office of State Planning. Input from the local planning staff was utilized to validate the projected socioeconomic data and current and anticipated land use plans.

The Base Year Network

The purpose of the traffic model is to replicate the conditions on the Rutherford County Urban Area street system. Therefore it is necessary to represent the existing street system in the model. There is a balance between having too many streets on the model to allow it to be calibrated and not having enough streets to realistically duplicate existing conditions. Generally, all the major arterials and some of the major land access or collector streets need to be represented.

Street capacity is an important component of the model. The volume/capacity ratio (v/c) gives us our best indication of present and future traffic congestion.

Speed and distance are the major factors that define the minimum time paths from zone to zone. The model uses the minimum time paths as the basis for assigning traffic to streets. Generally in the Rutherford County Urban Area model, the speeds assigned to links of the street system are at or slightly below the posted speed limit. Figure 12 shows the Tranplan Network overlaid on the actual street system.

Data Requirements

In order to produce an adequate traffic model of the study area, two additional types of data are required. First, traffic counts on routes used in the model provide a basis for calibrating the model. These traffic counts show a snapshot of traffic conditions in the study area. Second, socioeconomic data (housing counts and employment estimates) are necessary in order to generate traffic for the model. The housing and socioeconomic data for the model are shown in Figures 14 and 15.

RUTHERFORD COUNTY
TRANPLAN NETWORK

NETWORK

FIGURE 12

Traffic Counts

The model must be calibrated against existing conditions in the study area. In order to calibrate the model, traffic counts must be taken at various locations around the study area. The counts for much of the Rutherford County Urban Area study were collected during 1997. Traffic count locations are found in Figure 13.

Also, volumes on all routes crossing the planning area boundary were counted. These counts show how much traffic is entering and exiting the study area.

Socioeconomic Data

The required data consists of housing counts and employment estimates. The housing counts are used in the model as the generator of trips and employment is used as the attractor of trips.

The best indicator of the average number of trips made is from household income. Since there is no adequate method for determining household income, the type and quality of housing was used as an indicator of household income. The housing inventory was divided into five categories: excellent, above average, average, below average, and poor. Each of these categories was assigned a slightly different trip generation rate. Figure 14 shows the housing counts for each traffic zone.

The employment data that was collected was broken out by Standard Industrial Code classification and grouped into five categories: industry, special retail, retail, office and services. The number of employees in each category was estimated. This data was used with a regression equation developed from an origin and destination survey of a similar size area to produce an attraction factor for each zone. Figure 15 shows total employment by traffic analysis zone.

Commercial Vehicles

Commercial vehicles have somewhat different trip generation characteristics than privately owned vehicles. An inventory of commercial vehicles was done at the same time as the employment and housing inventory for the study area.

Trip Generation

The trip generation process is the process by which external station volumes, housing data, and employment data are used to generate traffic volumes that duplicate the traffic volumes on the street network. The technical definition of a trip is slightly different than the definition of a trip used by the general public. Technically a trip only has one origin and one destination while the layman will often group, or chain, several short trips together as one longer trip.

Traffic inside the study area has three major components: through trips, internal-external trips, and internal trips. Through trips are produced outside the planning area and pass through enroute to a destination outside the planning area. Internal-external trips have one end of the trip outside of the planning area. Internal trips have both their origin and destination inside the planning area. For clarity the internal trips are further subdivided into trip purposes. The trip purposes for the Rutherford County Urban Area are home-based work, other-home based, and non-home based.

Through Trips

The Through Trip Table for this study was developed based on Technical Report 3 (Synthesized Through Trip Table for Small Urban Areas By Dr. David G. Modlin, Jr.).

Once these volumes were developed, the Fratar balancing method was then used to balance the trip interchanges so that the total number of through trips at each external station is consistent with the total number of through trips at every other station. Generally five iterations are sufficient to balance the estimate between external zones.

External - Internal

The external-internal trip volume was determined by subtracting the through trip volume at each station from the total traffic volume at that station. See Table 11 for external-internal and through trip values.

Internal Data Summary (IDS)

IDS is the process that takes the external-internal traffic volumes, housing data, employment data, generation rates, and regression equations and generates the trip productions and trip attractions required by the gravity model. Housing units were stratified to account for differing trip generation rates for each classification. The individual trip generation rates give an average trip generation rate for the study area of 7.67 trips per dwelling unit (du) for 1997. This is within the state average of 7 to 8 trips per dwelling unit. Trip attractions were produced using regression equations. The regression equations consider trip attractions to be related to the employment characteristics of the traffic zones. The regression equations for Rutherford County Urban Area are:

$$HBW\ Y = 1.0X_1 + 1.0X_2 + 1.0X_3 + 1.0X_4 + 1.0X_5$$
$$OHB\ Y = .10X_1 + 2.0X_2 + 8.4X_3 + 2.6X_4 + 2.5X_5$$
$$NHB\ Y = .20X_1 + 2.0X_2 + 8.4X_3 + 2.6X_4 + 2.5X_5$$
$$EXT\ Y = .50X_1 + 2.0X_2 + 8.4X_3 + 2.6X_4 + 2.5X_5$$

Where:
- Y = Attraction factor for each zone
- X_1 = Industry (SIC codes 1-49)
- X_2 = Retail (SIC codes 55,58)
- X_3 = Special Retail (SIC codes 50-54, 56, 57, 59)
- X_4 = Office (SIC codes 60-67, 91-97)
- X_5 = Services (SIC codes 70-76, 78-89, 99)

The output of the IDS program are trip productions and trip attractions for each zone divided into four trip purposes: home-based work, non-home based, other home based, and external-internal. The trips are segregated into trip purposes because different trip lengths are associated with each trip purpose.

Internal Trip Distribution

Once the number of trips per traffic zones are determined, the trips must still be distributed to other traffic zones. The preferred method of distributing internal and external-internal trips, called the 'Gravity Model', states that the number of trips between Zone A and Zone B is equal to the number of trips produced in Zone A, multiplied by the number of trips attracted to Zone B, multiplied by a

travel time factor between the zones, then divided by the sum of all zone attractions multiplied by their travel time factors. The gravity model takes the form:

$$T_{ij} = \frac{P_i \times A_j \times F_{ij}}{\text{Sum } x=1,n \text{ of } A_x F_{t,x}}$$

T_{ij} = The number of trips produced in zone I and attracted to zone j.
P_i = The number of trips produced in zone i.
A_j = The number of trips attracted to zone j.
F_{ij} = The travel time factor.
n = The total number of zones.
i = The origin zone number.
j = The destination zone number.
x = Any zone number.

The travel time factor or friction factor (F) is critical to the gravity model distribution and must be derived empirically. The friction factor is dependent on the distance between the traffic zones and the time necessary to travel these distances. This factor is also dependent on the trip purpose. In order to derive this factor a gravity model calibration program is run with an initial friction factor and trip length frequency curve for each trip purpose. The initial friction factors used in the Rutherford County Urban Area model were 100 for all trip purposes and time increments. Table 12 shows the actual values used for the friction factors and trip length frequency curves.

Model Calibration

The purpose of a traffic model is to predict the traffic on a street system at some future point in time; however, if the model is not accurate, it is useless for this purpose. Therefore the model must duplicate the existing traffic pattern. The actual calibration of the model is an iterative process in which incremental changes are made either in the trip generation, trip distribution, or the street network. The purpose of each change is to allow the model to more accurately reflect the real world conditions upon which it is based. Only when the model can adequately reflect the existing traffic pattern should it be used to predict traffic in the future. The model was calibrated with 1996 and 1997 Average Daily Traffic Counts on all routes that it was available.

Accuracy Checks

There are three checks made on the model. The first is to follow trips through all the steps involved in the model. The purpose of this check is to insure that no trips have been accidentally added to or subtracted from the model, and that no trips have been counted twice.

The second check is to compare the model generated trips on the screenlines with the ground counts taken at the screenlines. A model is considered to accurately reflect the overall patterns if the trips it generates are from 95% to 105% of the ground counts on the screenlines. Table 9 compares the ground counts with the model traffic volumes on the screenlines. See Figure 7 for screenline locations.

The final check for the model is to match the traffic volumes on the links in the model with the ADT at the same locations. The 'link counts' can be used to find particular places in the network where

there are problems. Comparing the link counts with the ground counts for those links did not reveal any significant problems with the model.

Table 9

Actual vs. Model Screenline Total

Screenline	Ground Count	Model Volume	Percent
1 EW	85250	86009	1.01
2 NS (eastern)	47820	50060	1.05
3 NS (western)	37600	35800	0.95

Data Projections to the Design Year

In order to make use of the model the base year data must be modified to reflect assumed conditions in the design year. These projections and the previously developed regression equations were used to produce trip productions and attractions in the same manner as the base year.

Dwelling Unit Projections

Future dwelling units were determined by extending person per dwelling unit trends for the Rutherford County Urban Area linearly to the design year. The number of dwelling units are projected to increase by 24%. The Statewide Planning Unit projected residential growth and with the help of the local planning staff distributed these houses throughout the planning area. Figure 14 compares the classification of dwelling units in 1997 with the assumed classification in 2010.

Employment Projections

The Statewide Planning Unit and the local planning staff projected and distributed the 2010 employment to the zones they anticipated employment growth. Those projections were added to the 1997 data. Employment projections throughout the planning area indicated steady growth. Figure 15 compares the classification of employment data in 1997 with the assumed classification in 2010.

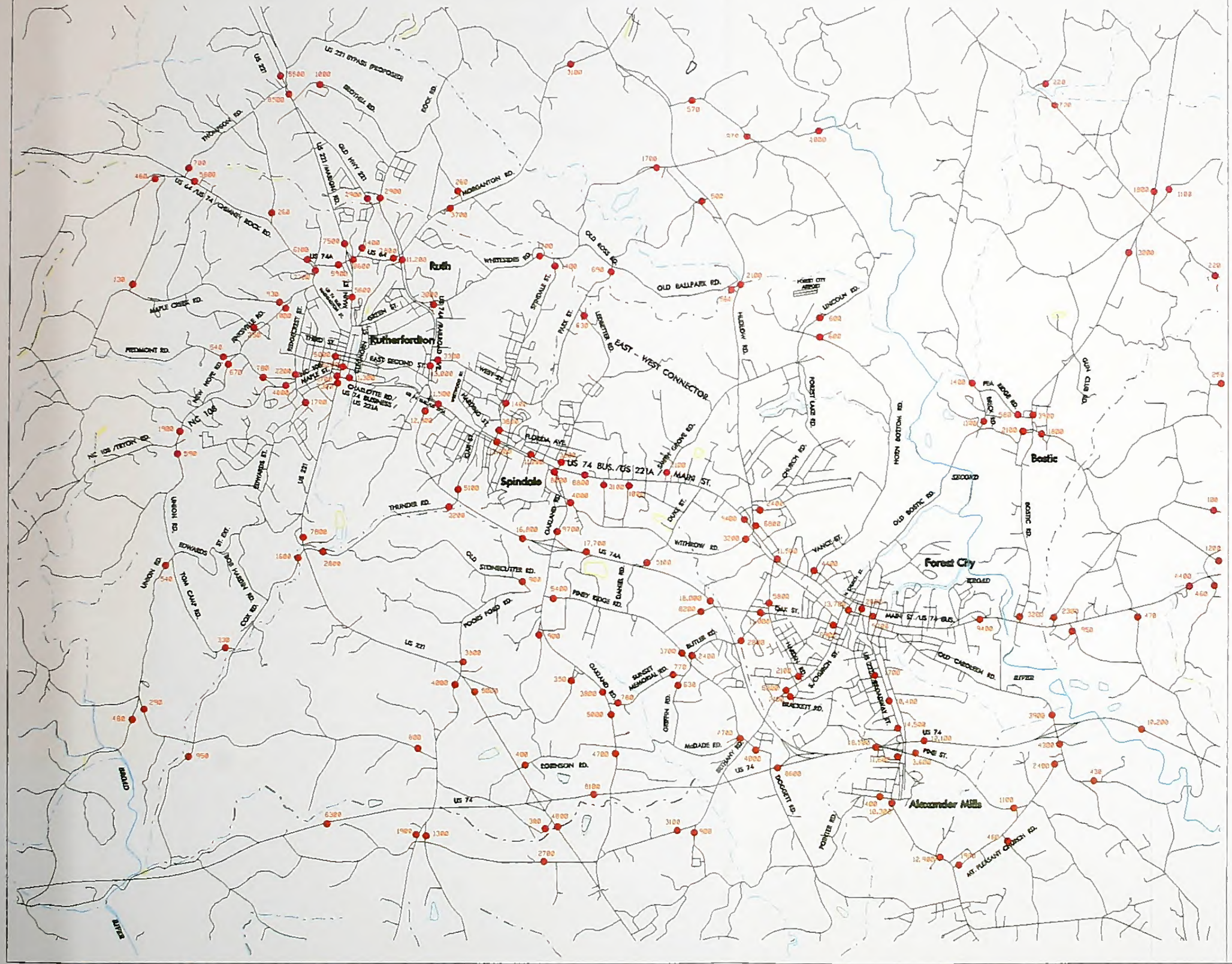
External and Through Trips

For the design year, external and through trips were projected from the base year using a linear projection of the past growth rate at each external station. Cordon Station Data can be found in Table 13.

RUTHERFORD COUNTY
1997 TRAFFIC COUNT LOCATIONS

TRAFFIC COUNT LOCATIONS

FIGURE 13



RUTHERFORD COUNTY

URBAN AREA

RUTHERFORD COUNTY

NORTH CAROLINA

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS - STATEWIDE PLANNING BRANCH
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

0 2000 4000 6000 8000
feet

0 1000 2000 3000
kilometers

RUTHERFORD COUNTY
HOUSING TOTALS BY ZONE

CORDON LINE

SCREEN LINE

ZONE LINE

HOUSING TOTALS

1997

2010

FIGURE 14

N

S

JULY 31, 1997

RUTHERFORD COUNTY

URBAN AREA

RUTHERFORD COUNTY

NORTH CAROLINA

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS - STATEWIDE PLANNING BRANCH
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

0 2000 4000 6000 8000
feet

0 1000 2000 3000
kilometers

RUTHERFORD COUNTY
EMPLOYMENT TOTALS BY ZONE

LEGEND

CORDON LINE

SCREEN LINE

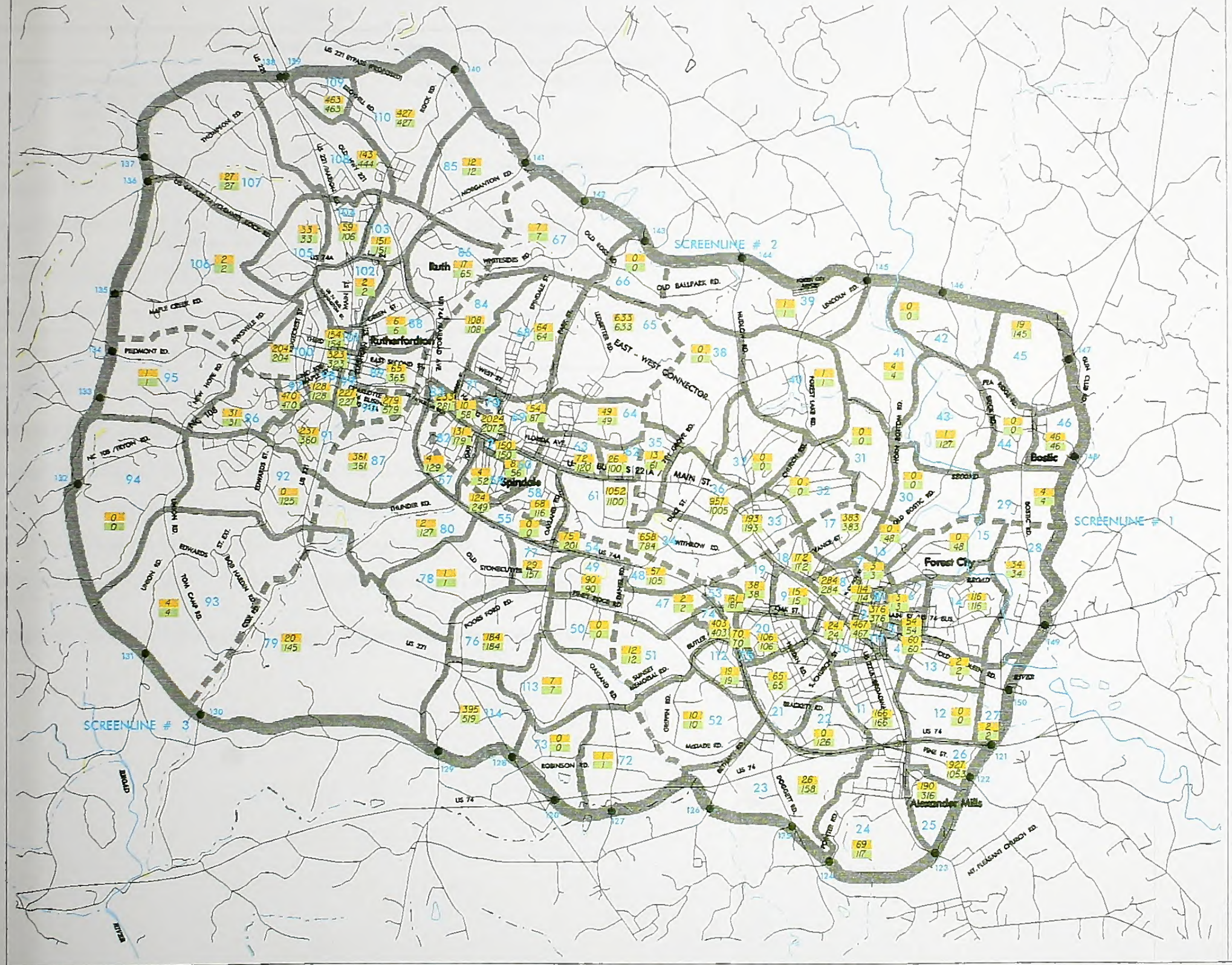
ZONE LINE

EMPLOYMENT TOTALS

1997

2010

FIGURE 15



JULY 31, 1997

RUTHERFORD COUNTY

URBAN AREA

RUTHERFORD COUNTY

NORTH CAROLINA

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS - STATEWIDE PLANNING BRANCH
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

0 2000 4000 6000 8000
feet

0 1000 2000 3000
kilometers

Table 10

Travel Model Input Variables

Trip Percentages by Purpose	Year	Persons/DU	Persons/Veh
Internal of Total 90%			
HBW 25%	1997	2.40	1.30
OHB 53%			
NHB 22%	2010	2.30	1.14

Composite Factor

$$\text{Composite Factor} = \frac{\text{1997 Persons/Veh}}{\text{2010 Persons/Veh}} \times \text{Usage Factor} \times \frac{\text{2010 Persons/DU}}{\text{1997 Persons/DU}}$$

Increase For Design Year Generation Rates

Generation Rates = Average 1997 Trip Rate X Composite Factor - Average 1997 Trip Rate

Increase for 2010 Generation Rates = 0.31 (7.67 X 1.04) - 7.67 = 0.31

The trip generation rates for 2010 were not increased.

Secondary NHB Trip Development

Secondary NHB Trips=(Total Ext-Int Trips - Ext-Int Trips Garaged Inside Planning Area) X 0.40*

1997 Secondary Trips = (74,476 - 8,275) X 0.40 = 26,480

2010 Secondary Trips = (106,946 - 11,883) X 0.40 = 38,025

The breakdown of internal trips by purpose and total of non-home based trips generated externally are shown in Table 11.

*Assumed NHB trip making rate per each one-way external-internal trip by vehicles garaged outside the planning area.

Table 11

Travel Data Summary

Type	1997	2010
Average Daily Trips per DU	7.67	7.67
Internal Trips	88,043	97,090
Home Based Work	19,810	21,845
Other Home Based	41,997	46,312
Non-Home Based, Internal	17,443	19,224
NHB Secondary	26,480	38,025
Internal <-> External	74,476	106,946
Through Trips	30,424	67,080

Table 12

Friction Factors & Travel Curve Data
Rutherford County Urban Area

	Friction Factors				Travel Curves			
					% Trips Distributed			
Time Interval	HBW	OHB	NHB	Ext - Int	HBW	OHB	NHB	Ext-Int
1	49887	210673	86870	250572	0.00	0.00	0.00	4.1
2	51223	88105	73021	83178	20.77	28.74	30.00	9.8
3	38530	40645	43244	36995	23.89	24.42	34.50	7.6
4	22794	20253	19941	20763	21.34	18.22	20.20	6.8
5	11385	10674	7913	13848	16.05	12.59	9.70	8.6
6	5155	5826	2987	10337	10.39	7.82	3.80	17.6
7	2271	3224	1185	8133	5.48	4.29	1.30	13.9
8	1046	1772	546	6351	1.80	2.30	0.50	12.7
9	540	947	323	4636	0.28	1.24	0.00	8.9
10	336	482	271	2980	0.00	0.38	0.00	7.1
11	270	228	358	1588	0.00	0.00	0.00	2.9

Table 13

Cordon Station Travel

Computer Station	Base Year - 1997			Future Year - 2010		
	Total ADT	Through Trip End	Ext - Int Trips	Total ADT	Through Trip End	Ext - Int Trips
120	8,400	4,250	4,150	14,000	6,994	7,006
121	9,700	3,532	6,168	20,100	13,224	6,876
122	1,200	260	940	1,880	152	1,728
123	12,200	4,384	7,816	19,000	11,960	7,040
124	1,700	1,288	412	2,100	176	1,924
125	4,000	1,296	2,704	5,750	1,218	4,532
126	4,400	510	3,890	4,950	944	4,006
127	5,200	1,150	4,050	6,800	1,722	5,078
128	5,200	3,722	1,478	10,000	4,676	5,324
129	3,800	894	2,906	5,580	1,076	4,504
130	1,600	516	1,084	1,600	140	1,460
131	2,000	1,730	270	800	52	748
132	2,450	516	1,934	4,000	720	3,280
133	900	342	558	1,200	74	1,126
134	550	128	422	800	38	762
135	1,100	560	540	1,500	106	1,394
136	800	498	302	1,200	74	1,126
137	6,000	2,794	3,206	7,800	2,412	5,388
138	7,300	2,760	4,630	15,000	7,890	7,110
139	900	492	408	1,200	374	826
140	3,400	2,634	766	4,000	658	3,342
141	3,700	1,954	1,746	5,500	1,372	4,128
142	1,700	424	1,276	2,500	280	2,220
143	550	118	432	800	40	760
144	2,800	552	2,248	4,000	592	3,408
145	600	278	322	900	50	850
146	1,400	654	746	2,100	104	1,996
147	4,400	1,984	2,416	6,300	1,516	4,784
148	2,200	1,524	676	3,200	408	2,792
149	9,600	2,302	7,298	14,000	6,992	7,008
150	3,900	1,000	2,900	5,700	1,280	4,420

Appendix A

Thoroughfare Planning Principles

There are many advantages to thoroughfare planning, but the primary mission is to assure that the road system will be progressively developed to serve future travel desires. Thus, the main consideration in thoroughfare planning is to make provisions for street and highway improvements so that, when the need arises, feasible opportunities to make improvements exist.

Benefits of Thoroughfare Planning

There are two major benefits derived from thoroughfare planning. First, each road or highway can be designed to perform a specific function and provide a specific level of service. This permits savings in right-of-way, construction, and maintenance costs. It also protects residential neighborhoods and encourages stability in travel and land use patterns. Second, local officials are informed of future improvements and can incorporate them into planning and policy decisions. This will permit developers to design subdivisions in a non-conflicting manner, direct school and park officials to better locate their facilities, and minimize the damage to property values and community appearance that is sometimes associated with roadway improvements.

Thoroughfare Classification Systems

Streets perform two primary functions, traffic service and land access, which when combined, are basically incompatible. The conflict is not serious if both traffic and land service demands are low. However, when traffic volumes are high, conflicts created by uncontrolled and intensely developed abutting property lead to intolerable traffic flow friction and congestion.

The underlying concept of the thoroughfare plan is that it provides a functional system of streets that permits travel from origins to destinations with directness, ease and safety. Different streets in this system are designed and called on to perform specific functions, thus minimizing the traffic and land service conflict.

Urban Classification

In the urban thoroughfare plan, elements are classified as major thoroughfares, minor thoroughfares, or local access streets.

Major Thoroughfares

These routes are the primary traffic arteries of the urban area and they accommodate traffic movements within, around, and through the area.

Minor Thoroughfares

Roadways classified under this type collect traffic from the local access streets and carry it to the major thoroughfare system.

Local Access Streets

This classification covers streets that have a primary purpose of providing access to the abutting property. This classification may be further classified as either residential, commercial and/or industrial depending upon the type of land use that they serve.

Idealized Major Thoroughfare System

The coordinated system of major thoroughfares that is most adaptable to the desired lines of travel within an urban area and that is reflected in most urban area thoroughfare plans is the radial-loop system. The radial-loop system includes radials, crosstowns, loops, and bypasses (Figure A-1).

Radial streets provide for traffic movement between points located on the outskirts of the city and the central area. This is a major traffic movement in most cities, and the economic strength of the central business district depends upon the adequacy of this type of thoroughfare.

If all radial streets crossed in the central area, an intolerable congestion problem would result. To avoid this problem, it is very important to have a system of crosstown streets that form a loop around the central business district. This system allows traffic moving from origins on one side of the central area to destinations on the other side to follow the area's border. It also allows central area traffic to circle and then enter the area near a given destination. The effect of a good crosstown system is to free the central area of crosstown traffic, thus permitting the central area to function more adequately in its role as a business or pedestrian shopping area.

Loop system streets move traffic between suburban areas of the city. Although a loop may completely encircle the city, a typical trip may be form an origin near a radial thoroughfare to a destination near another radial thoroughfare. Loop streets do not necessarily carry heavy volumes of traffic, but they function to help relieve central areas. There may be one or more loops, depending on the size of the urban area. They are generally spaced one-half mile to one mile apart, depending on the intensity of land use.

A bypass is designed to carry traffic through or around the urban area, thus providing relief to the city street system by removing traffic that has no desire to be in the city. Bypasses are usually designed to through-highway standards, with control of access. Occasionally, a bypass with low traffic volume can be designed to function as a portion of an urban loop. The general effect of bypasses is to expedite the movement of through traffic and to improve traffic conditions within the city. By freeing the local streets for use by shopping and home-to-work traffic, bypasses tend to increase the economic vitality of the local area.

Objectives of Thoroughfare Planning

Thoroughfare planning is the process public officials use to assure the development of the most appropriate street system that will meet existing and future travel desires within the urban area. The primary aim of a thoroughfare plan is to guide the development of the urban street system in a manner consistent with the changing traffic patterns. A thoroughfare plan will enable street improvements to be made as traffic demands increase, and it helps eliminate unnecessary improvements, so needless expense can be averted. By developing the urban street system to keep pace with increasing traffic demands, a maximum utilization of the system can be attained, requiring a minimum amount of land for street purposes. In addition to providing for traffic needs the thoroughfare plan should embody those details of good urban planning necessary to present a pleasing and efficient urban community. The location of present and future population, commercial

and industrial development affect major street and highway locations. Conversely, the location of major streets and highways within the urban area will influence the urban development pattern.

Other objectives of a thoroughfare plan include:

* To provide for the orderly development of an adequate major street system as land development occurs;

* To reduce travel and transportation costs;

* To reduce the cost of major street improvements to the public through the coordination of the street system with private action;

* To enable private interest to plan their actions, improvements, and development with full knowledge of public intent;

* To minimize disruption and displacement of people and businesses through long range advance planning for major street improvements;

* To reduce environmental impacts, such as air pollution, resulting from transportation, and

* To increase travel safety.

These objectives are achieved through improving both the operational efficiency of thoroughfares, and improving the system efficiency through system coordination and layout.

Operational Efficiency

A street's operational efficiency is improved by increasing the capability of the street to carry more vehicular traffic and people. In terms of vehicular traffic, a street's capacity is defined by the maximum number of vehicles which can pass a given point on a roadway during a given time period under prevailing roadway and traffic conditions. Capacity is affected by the physical features of the roadway, nature of traffic, and weather.

Physical ways to improve vehicular capacity include:

* **Street widening -** widening of a street from two to four lanes more than doubles the capacity of the street by providing additional maneuverability for traffic.

* **Intersection improvements -** increasing the turning radii, adding exclusive turn lanes, and channelizing movements can improve the capacity of an existing intersection.

* **Improving vertical and horizontal alignment -** reduces the congestion caused by slow moving vehicles.

* **Eliminating roadside obstacles -** reduces side friction and improves a driver's field of sight.

Operational ways to improve street capacity include:

* **Control of Access -** a roadway with complete access control can often carry three times the traffic handled by a non-controlled access street with identical lane width and number.

* **Parking removal** - Increases capacity by providing additional street width for traffic flow and reducing friction to flow caused by parking and unparking vehicles.

* **One-way operation** - The capacity of a street can sometimes be increased 20 -50%, depending upon turning movements and overall street width, by initiating one-way traffic operations. One-way streets can also improve traffic flow by decreasing potential traffic conflicts and simplifying traffic signal coordination.

* **Reversible lane** - Reversible traffic lanes may be used to increase street capacity in situations where heavy directional flows occur during peak periods.

* **Signal phasing and coordination** - Uncoordinated signals and poor signal phasing restrict traffic flow by creating excessive stop-and-go operation.

Altering travel demand is a third way to improve the efficiency of existing streets. Travel demand can be reduced or altered in the following ways:

* **Carpools** - Encourage people to form carpools and vanpools for journeys to work and other trip purposes. This reduces the number of vehicles on the roadway and raises the people carrying capability of the street system.

* **Alternate mode** - Encourage the use of transit and bicycle modes.

* **Work hours** - Encourage industries, businesses, and institutions to stagger work hours or establish variable work hours for employees. This will spread peak travel over a longer time period and thus reduce peak hour demand.

* **Land use** - Plan and encourage land use development or redevelopment in a more travel efficient manner.

System Efficiency

Another means for altering travel demand is the development of a more efficient system of streets that will better serve travel desires. A more efficient system can reduce travel distances, time, and cost to the user. Improvements in system efficiency can be achieved through the concept of functional classification of streets and development of a coordinated major street system.

Application of Thoroughfare Planning Principles

The concepts presented in the discussion of operational efficiency, system efficiency, functional classification, and idealized major thoroughfare system are the conceptual tools available to the transportation planner in developing a thoroughfare plan. In actual practice thoroughfare planning is done for established urban area and is constrained by existing land use and street patterns, existing public attitudes and goals, and current expectations of future land use. Compromises must be made because of these and the many other factors that affect major street locations.

Through the thoroughfare planning process it is necessary from a practical viewpoint that certain basic principles be followed as closely as possible. These principles are listed below:

1. The plan should be derived from a thorough knowledge of today's travel - its component parts, and the factors that contribute to it, limit it, and modify it.

2. Traffic demands must be sufficient to warrant the designation and development of each major street. The thoroughfare plan should be designed to accommodate a large portion of major traffic movements on a few streets.

3. The plan should conform to and provide for the land development plan for the area.

4. Certain considerations must be given to urban development beyond the current planning period. Particularly in outlying or sparsely developed areas that have development potential, it is necessary to designate thoroughfares on a long-range planning basis to protect rights-of-way for future thoroughfare development.

5. While being consistent with the above principles and realistic in terms of travel trends, the plan must be economically feasible.

IDEALIZED THOROUGHFARE PLAN

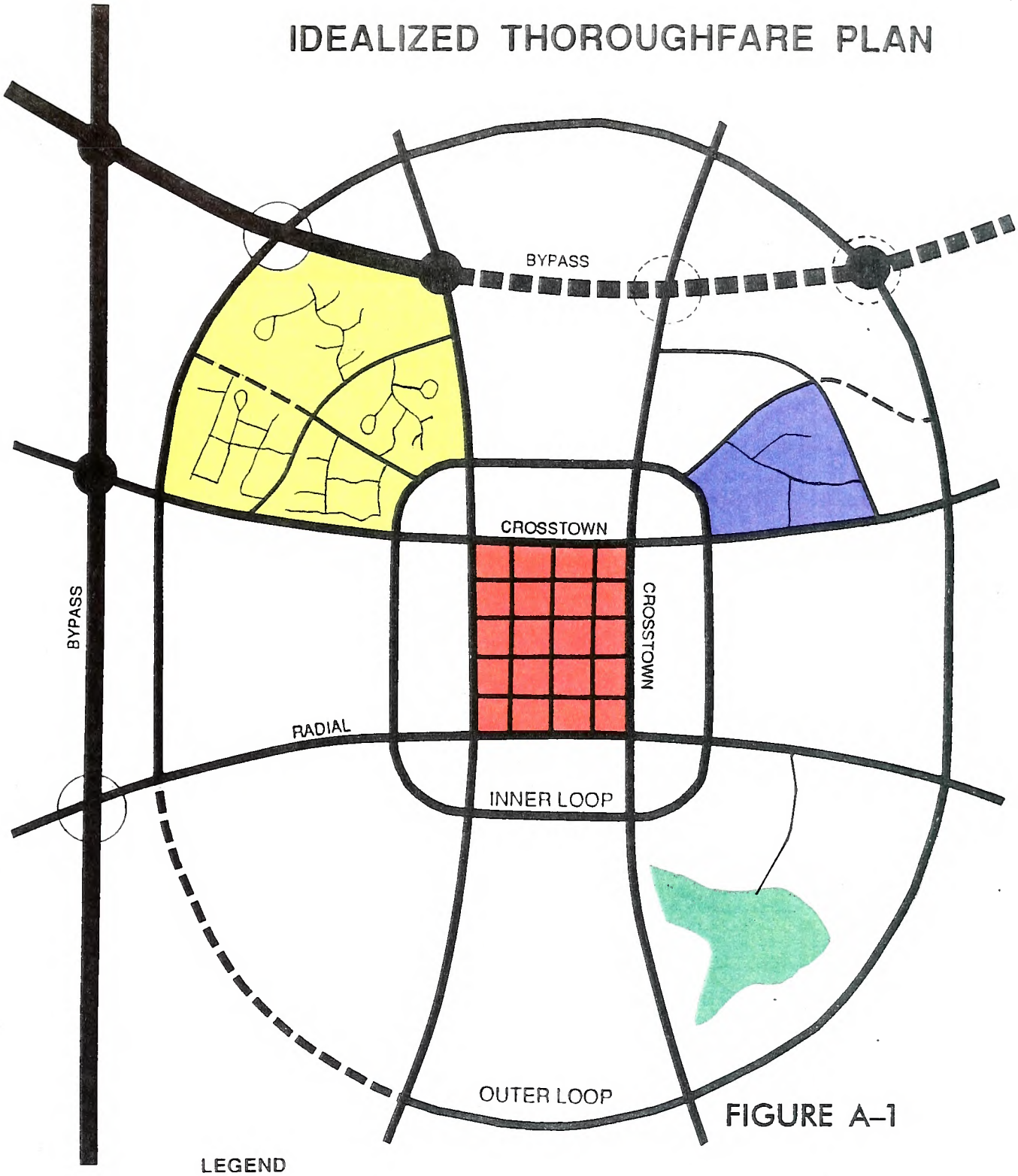


FIGURE A–1

LEGEND

	EXISTING	PROPOSED
MAJOR THOROUGHFARE FREEWAY		
MAJOR OTHER		
MINOR THOROUGHFARE		
LOCAL ROAD		
INTERCHANGE		
GRADE SEPERATION		

LAND USES

- COMMERCIAL/BUSINESS
- RESIDENTIAL
- INDUSTRIAL
- PUBLIC/INSTITUTIONAL

Appendix B

Thoroughfare Plan Street Tabulation and Recommendations

This appendix includes a detailed tabulation of all streets identified as elements of the Rutherford County Urban Area Thoroughfare Plan. The table includes a description of each section, as well as the length, cross section, and right-of-way for each section. Also included are existing and projected average daily traffic volumes, roadway capacity, and the recommended ultimate lane configuration. Due to space constraints, these recommended cross sections are given in the form of an alphabetic code. A detailed description of each of these codes and a illustrative figure for each can be found in Appendix C.

The following index of terms may be helpful in interpreting the table:

NPAB - Northern Planning Area Boundary

EPAB - Eastern Planning Area Boundary

WPAB - Western Planning Area Boundary

SPAB - Southern Planning Area Boundary

NCL - Northern City Limits

SCL - Southern City Limits

WCL - Western City Limits

ECL - Eastern City Limits

ADQ - Adequate

N/A - Not Available

Appendix B

Thoroughfare Plan Street Tabulation and Recommendation

FACILITY & SECTION	EXISTING X-SECTION DIST MI	RDWY FT	ROW FT	NUMBER OF LANES	PRACTICAL CAPACITY CURRENT (FUTURE)	1997 ADTS	2010 ADTS	RECOMMENDED X - SECTION RDWY (ULT)	ROW (ULT)
US 64, Chimney Rock Rd									
WPAB - US 74 Bus.	1.10	22	60	2	11,000	5,600	9,400	(K)	(100)
US 74 Bus.- US 221	0.30	24	60	2	12,000	5,900	7,000	(K)	(100)
US 221 - US 74 A	0.50	24	60	2	12,000	8,000	9,000	(K)	(100)
US 74 A - US 221 Byp	0.20	24	60	2	12,000	3,700	5,000	(K)	(100)
US 221 Byp - EPAB	0.10	24	60	2	12,000	3,100	5,500	(K)	(100)
US 74									
WPAB - US 221	0.50	48	290	4	54,000	6,300	14,000	ADQ	ADQ
US 221 - US 74 A	2.75	48	290	4	54,000	8,600	14,000	ADQ	ADQ
US 74 A - US 221 A	1.37	48	290	4	54,000	19,000	20,000	ADQ	ADQ
US 221 A - Old Caroleen	1.35	48	290	4	54,000	12,100	21,000	ADQ	ADQ
Old Caroleen - EPAB	0.50	48	290	4	54,000	10,200	21,000	ADQ	ADQ
US 74 A									
US 64 - Whitesides Rd	0.50	26	60	2	12,000	11,400	7,000	ADQ	ADQ
Whitesides Rd - US 74 Bus	1.07	24	60	2	[20000]	13,000	16,500	F	100
US 74 Bus - Thunder Rd	1.20	48	290	4	40,000	13,000	15,000	ADQ	ADQ
Thunder Rd - Oakland Rd	1.10	48	290	4	40,000	17,000	20,000	ADQ	ADQ
Oakland Rd - Daniel Rd	0.84	48	290	4	40,000	17,700	25,000	ADQ	ADQ
Daniel Rd - Oak St	1.00	48	290	4	40,000	18,000	25,000	ADQ	ADQ
Oak St - Butler Rd	0.42	48	290	4	40,000	18,500	20,000	ADQ	ADQ
Butler Rd - Church St	0.80	48	290	4	40,000	18,600	20,000	ADQ	ADQ
Church St - US 74	1.01	48	290	4	40,000	19,000	21,000	ADQ	ADQ
US 74 A Extension (Alex. Mills Conn.)									
US 74 - US 221 A	1.41			4	[40000]		12,600	A	228
US 74 Business									
US 64 - Maple Creek Rd	0.23	24	60	2	12,000	7,700	11,300	ADQ	ADQ
Maple Creek Rd - NC 108	0.86	24-32	60	2	12,000	6,000	8,100	ADQ	ADQ
NC 108 - US 221	0.10	38	60	2	12,000	9,700	11,300	ADQ	ADQ
US 221 - US 74 A (Charlotte Rd)	1.42	52-64	70-140	4	20,000	11,300	12,300	ADQ	ADQ
US 74 A - Oak St (Spindale)	0.62	35	60	2	[25000]	11,500	16,000	(C)	100
Oak St - Spindale St.	0.20	50	60	2	[25000]	12,000	14,500	(C)	100
Spindale St - Ledbetter Rd	0.68	44-50	60	2	[25000]	12,000	14,500	(C)	100
Ledbetter Rd - Smith Grove	1.07	36	100	2	[25000]	9,200	11,000	(C)	100
Smith Grove - Duke St	0.17	36	100	2	[25000]	9,700	10,500	(C)	100
Duke St - Hudlow Rd	0.91	36	60	2	[25000]	9,400	10,700	(C)	100
Hudlow Rd - Vance St	0.76	36	60	2	[25000]	11,500	15,800	(C)	100
Vance St - S Church St	0.55	32	60	2	[25000]	12,000	14,000	(C)	100
S Church St - US 221 A	0.36	40	60	2	[25000]	13,700	15,000	(C)	100
US 221 A - Bostic Rd	1.12	28-40	60	2	[25000]	9,700	15,500	(C)	100
Bostic Rd - EPAB	0.24	24	60	2	[25000]	7,800	14,000	(C)	100

Appendix B

Thoroughfare Plan Street Tabulation and Recommendation

FACILITY & SECTION	ENGLISH UNITS DIST MI	RDWY FT	ROW FT	NUMBER OF LANES	PRACTICAL CAPACITY CURRENT (FUTURE)	1997 ADTS	2010 ADTS	RECOMMENDED X - SECTION RDWY (ULT)	ROW (ULT)
US 221									
NPAB - Thompson Rd	0.63	24	100	2	[40000]	5,700	15,000	A	228
Thompson Rd - Old 221	0.24	24	100	2	[40000]	8,500	7,000	A	228
Old 221 - US 64	1.68	24	60	2	12,000	7,500	6,000	ADQ	ADQ
US 64 - Green St	0.69	30	60	2	12,000	5,600	5,000	ADQ	ADQ
Green St - 4 th St	0.30	30	60	2	10,000	6,000	7,000	ADQ	ADQ
4 th St - W Court St	0.20	50	60	2	10,000	6,200	7,000	ADQ	ADQ
W. Court St - US 74 Bus	0.30	40	60	2	10,000	6,300	7,500	ADQ	ADQ
US 74 Bus - Cox Rd	1.84	20	60	2	12,000	7,400	7,500	ADQ	ADQ
Cox Rd - Poors Ford Rd	2.13	20	60	2	12,000	6,400	8,500	ADQ	ADQ
Poors Ford Rd - US 74	1.72	20	60	2	[40000]	5,000	10,000	A	228
US 74 - SPAB	1.50	20	60	2	[40000]	4,800	10,000	A	228
US 221 A/US 74 Bus									
US 221 - US 74 A		SEE US 74 BUS							
US 74 A - Broadway St		SEE US 74 BUS							
US 74 Bus - US 74	1.31	34	100	2	[25000]	14,500	20,000	C	ADQ
US 74 - Pine St	0.11	54	100	2	[25000]	12,900	16,000	C	ADQ
Pine St - Pointer St	0.48	34	100	2	[25000]	11,600	15,000	C	ADQ
Pointer St - US 74 A Ext	0.65	32	100	2	[25000]	12,900	10,000	C	ADQ
US 74 A Ext - SPAB	0.50	24-32	100	2	[25000]	11,800	19,000	C	ADQ
US 221 Bypass									
US 221 - US 64	2.76			4	[40000]		13,000	A	228
US 64 - West St	1.59			4	[40000]		15,000	A	228
West St - Thunder Rd	2.23			4	[40000]		4,000	A	228
Thunder Rd - US 221	0.94			4	[40000]		6,000	A	228
NC 108 (Tyron Road)									
WPAB - Union Road	1.04	24	60	2	12,000	2,600	4,400	(K)	(100)
Union Rd - Piedmont Rd	1.11	20	60	2	10,000	3,600	5,600	(K)	(100)
Piedmont Rd - Ridgecrest St	0.22	20	60	2	10,000	4,000	6,400	(K)	(100)
NC 108 (Ridgecrest St)									
Tryon Rd - Maple Creek Rd	0.96	20	60	2	10,000	3,000	5,000	(K)	(100)
NC 108 (Maple St)									
Ridgecrest St - US 74 Bus	0.40	37	60	2	12,000	5,300	8,000	ADQ	ADQ
Bethany Rd (SR 2213)									
US 74 A - Doggett Rd	0.30	20	60	2	10,000	5,200	8,000	(K)	(100)
Doggett Rd - US 74	0.27	20	60	2	10,000	3,800	5,000	(K)	(100)
US 74 - SPAB	0.45	20	60	2	10,000	3,100	5,000	(K)	(100)

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Thoroughfare Plan Street Tabulation and Recommendation

FACILITY & SECTION	ENGLISH UNITS DIST MI	RDWY FT	ROW FT	NUMBER OF LANES	PRACTICAL CAPACITY CURRENT (FUTURE)	1997 ADTS	2010 ADTS	RECOMMENDED X - SECTION RDWY (ULT)	ROW (ULT)
Bob Hardin Rd (SR 1151)									
Edward St - Cox Rd	0.83	18	60	2	7,000	200	500	ADQ	ADQ
Bostic Rd (SR 1006)									
US 74 Bus - Old Bostic Rd	1.91	18-24	60	2	8,500	3,200	4,500	(K)	(100)
Old Bostic Rd - Pea Ridge Rd	0.24	20	60	2	10,000	3,500	4,500	(K)	(100)
Pea Ridge Rd - NPAB	0.66	20	60	2	10,000	3,900	6,300	(K)	(100)
Bostic Road Extension									
US 74 Bus - Old Caroleen Rd	0.76			4	[20000]		2,000	F	100
Brackett Rd (SR 2177)									
S Church St - Broadway St	1.06	25	60	2	11,500	2,000	3,000	(K)	(100)
Brick Rd (SR 1583)									
Old Bostic Rd - Pea Ridge Rd	0.46	18	60	2	7,000	1,100	2,200	(K)	(100)
Pea Ridge Rd - NPAB	0.70	18	60	2	7,000	1,400	2,200	(K)	(100)
Broadway St (US 221 A)									
US 74 Bus - SPAB		SEE US 221 A							
Broyhill Road (SR 1535)									
US 221 - Rock Road	1.47	20	60	2	10,000	1,000	1,500	(K)	(100)
Butler Rd (SR 2179)									
Piney Ridge Rd - US 74 A	0.63	18	60	2	8,500	2,400	3,200	(K)	(100)
US 74 A - Oak St (Forest City)	0.43	18	60	2	8,500	2,800	4,200	(K)	(100)
Charlotte Rd (US 74 Bus)									
US 221 - US 74 A	SEE US 74 Business								
Church Rd (SR 1586)									
Forest Lake Rd - Hudlow Rd	0.94	18	60	2	8,500	2,400	3,200	(K)	(100)
Church Street (North)									
Luckadoo St - Trade Street	0.86	14	40	2	6,000	1,200	1,800	(K)	(100)
Church St (S) (SR 2213)									
US 74 Bus-Oak St (Forest City)	0.20	46	60	2	12,000	5,500	6,500	ADQ	ADQ
Oak St - US 74 A	1.21	20	60	2	9,000	5,800	6,800	(K)	(100)
Cleghorn Street									
US 74 Bus - Green Street	0.59	24	60	2	12,000	3,000	4,000	ADQ	ADQ

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FACILITY & SECTION	ENGLISH UNITS DIST MI	RDWY FT	ROW FT	NUMBER OF LANES	PRACTICAL CAPACITY CURRENT (FUTURE)	1997 ADTS	2010 ADTS	RECOMMENDED X - SECTION RDWY (ULT)	ROW (ULT)
Cox Road (SR 1005)									
WPAB - US 221	2.27	18	60	2	8,500	1,600	3,000	(K)	(100)
Daniel Rd (SR 2184)									
Piney Ridge Rd - US 74 A	0.49	18	60	2	[12000]	1,000	10,000	K	100
US 74 A - Withrow Rd	0.38	22	60	2	[12000]	5,100	12,800	K	100
Daniel Rd Extension									
Withrow Rd - US 74 Bus	0.51			2	[12000]		4,000	K	100
Daniel Rd Extension									
Piney Ridge Rd - Oak St Ext.	0.34			2	[12000]		4,000	K	100
Doggett Rd (SR 2159)									
Bethany Rd - Pointer Rd	1.40	18	60	2	8,500	4,000	5,700	(K)	(100)
Pointer Rd - US 221 A	1.50	20	60	2	10,000	3,200	5,700	(K)	(100)
Duke Street (SR 2184)									
US 74 Bus - Withrow Rd	0.68	20	50	2	8,000	5,100	2,500	(K)	(100)
Edwards Street + Ext. (SR 1153)									
Maple St - Bob Hardin Rd	1.83	18	60	2	8,500	1,700	4,800	(K)	(100)
Bob Hardin Rd - Union Rd	1.17	18	60	2	8,500	500	800	(K)	(100)
Florida Ave									
Spindale St - Ledbetter Rd	0.68	24	60	2	12,000	2,000	2,800	ADQ	ADQ
Forest Lake Rd (SR 1586)									
Smith Grove Rd - Church Rd	0.86	18	60	2	8,500	700	1,000	(K)	(100)
Green Street									
US 221 - Railroad Ave	0.66	25	60	2	12,000	1,000	1,970	ADQ	ADQ
Griffin Road (SR 2198)									
McDade Road - Piney Ridge Rd	0.86	18	60	2	8,500	630	1,000	(K)	(100)
Hardin Rd (SR 2178)									
West Main Dr - Oak St	0.52	24	60	2	12,000	5,800	8,200	ADQ	100
Oak St - South Church St	0.75	24	60	2	12,000	2,100	4,500	ADQ	100
Horn Bottom Rd/Vance St (SR 1585)									
US 74 Bus - Old Lincoln Rd	3.16	20-28	60	2	[12000]	4400-600	7500-1000	K	100

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Thoroughfare Plan Street Tabulation and Recommendation

FACILITY & SECTION	ENGLISH UNITS DIST MI	RDWY FT	ROW FT	NUMBER OF LANES	PRACTICAL CAPACITY CURRENT (FUTURE)	1,997 ADTS	2,010 ADTS	RECOMMENDED X - SECTION RDWY (ULT)	ROW (ULT)
Horn Bottom Rd Extension									
Lincoln Rd - Hudlow Rd	0.84			2	[12000]		1,000	K	100
Hudlow Rd (SR 1510)									
US 74 Bus - Smith Grove Rd	1.36	20	100	2	[12000]	6,800	9,000	K	ADQ
Smith Grove Rd - NPAB	1.20	20	100	2	[12000]	3,300	4,500	K	ADQ
Junksville Rd (SR 1164)									
Piedmont Rd - Maple Creek Rd	0.81	20	60	2	11,000	1,000	1,300	ADQ	ADQ
Ledbetter Rd (SR 1591)									
US 74 Bus - Park St	1.82	18-22	60	2	9,000	3300-630	4,000	(K)	(100)
Ledbetter Rd Extension									
Park St - Spindale St	0.37			2	[12000]		4,000	K	100
Main St (Forest City)			SEE US 74 BUS (US 221 A/Main Street)						
Main St (Rutherfordton)			SEE US 221						
Main St (Spindale)			SEE US 74 BUS						
Maple Street (NC 108)									
Ridgecrest Rd - Washington St			SEE NC 108						
Maple Creek Rd (SR 1178)									
US 74 Bus - Junksville Rd	0.24	22	60	2	11,000	3,000	6,200	(K)	(100)
Junksville Rd - WPAB	2.10	22	60	2	11,000	930	2,300	(K)	(100)
Marion Rd (US 221)									
NPAB - US 64/Us 74			SEE US 221						
McDade Rd (SR 2214)									
Oakland Rd - Piney Ridge Rd	1.50	20	60	2	10,000	430	2,400	(K)	(100)
Morganton Rd (US 64)									
US 74 A - EPAB			SEE US 64						
Mt Pleasant Church Rd (SR 1906)									
US 221 A - Old Caroleen Rd	1.56	19	60	2	8,500	2,400	4,000	(K)	(100)
New Hope Rd (SR 1164)									
NC 108 - Maple Creek Rd	1.46	18	60	2	8,500	670	1,000	(K)	(100)

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FACILITY & SECTION	ENGLISH UNITS DIST MI	RDWY FT	ROW FT	NUMBER OF LANES	PRACTICAL CAPACITY CURRENT (FUTURE)	1,997 ADTS	2,010 ADTS	RECOMMENDED X - SECTION RDWY (ULT)	ROW (ULT)
Oak St (SR 2179) Forest City									
Piney Ridge Rd - US 74 A	0.63	20	60	2	[25000]	8,200	11,800	C	100
US 74 A - Hardin Rd	0.51	52	60	4	[25000]	11,000	16,000	C	100
Hardin Rd - S Church St	0.67	20	60	2	[25000]	6,900	16,000	C	100
Oak St Extension (West)									
Piney Ridge Rd - Oakland Rd	0.95			5	[25000]		12,000	C	100
Oakland Rd - US 221	0.90			5	[25000]		12,000	C	100
Oak St Extension (East)									
S Church St - Old Caroleen Rd	1.50			5	[25000]		16,000	C	100
Oak St (SR 2201) Spindale									
Spindale St - US 74 Bus	0.29	27-45	60	2	10,500	2,500	3,800	ADQ	ADQ
US 74 Bus - US 74 A	0.70	48	60	4	20,000	5,100	10,500	ADQ	ADQ
Oakland Rd (SR 2169)									
US 74 Bus - US 74 A	0.81	22	60	2	11,000	9,700	11,000	(K)	(100)
US 74 A - Piney Ridge Rd	0.47	22	60	2	11,000	7,000	8,000	(K)	(100)
Piney Ridge Rd - SPAB	2.40	22	60	2	11,000	4,700	6,800	(K)	(100)
Old Ballpark Rd (SR 1548)									
Park St - Hudlow Road	1.40	20	60	2	10,000	560	1,000	(K)	(100)
Old Bostic Rd (SR 1576)									
Cherry Mountain - Brick Rd	1.32	18	60	2	8,500	1,100	2,400	(K)	(100)
Brick Rd - Bostic Rd	0.60	20-28	60	2	10,000	1,100	1,500	(K)	(100)
Old Caroleen Rd (SR 1901)									
Arlington Rd - Bostic Rd Extension	2.00	24-30	60	2	12,000	4,000	5,200	ADQ	ADQ
Bostic Rd Extension - US 74	0.19	24	60	2	[20000]	3,900	5,200	F	100
US 74 - SPAB	0.60	24	60	2	12,000	4,300	5,700	ADQ	ADQ
Old Hwy 221 (SR 1536)									
US 221 - US 64	1.75	20	60	2	10,000	2,900	4,000	(K)	(100)
Old Ross Road (SR 1548) & Ext.									
Park St - Whitesides Rd	0.44	20	60	2	10,000	1,000	1,400	(K)	(100)
Whitesides Rd - US 64	0.91			2	[12000]		3,300	K	100
Old Stonecutter Rd (SR 2193)									
Poors Ford Rd - Gravel starts	1.60	18	60	2	9,000	900	3,400	(K)	(100)
Gravel starts - Thunder Rd	0.60	18	60	2	9,000	900	2,100	(K)	(100)

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FACILITY & SECTION	ENGLISH UNITS DIST MI	RDWY FT	ROW FT	NUMBER OF LANES	PRACTICAL CAPACITY CURRENT (FUTURE)	1,997 ADTS	2,010 ADTS	RECOMMENDED X - SECTION RDWY (ULT)	ROW (ULT)
Old Stonecutter Rd Extension									
Old Stonecutter - Thunder Rd	0.40			2	[12000]		1,300	K	100
Park St (SR 1547)									
Old Ballpark - Ledbetter Rd	0.59	23	60	2	11,000	500	800	(K)	(100)
Ledbetter Rd - Stonecutter St	1.18	21	60	2	10,000	700	900	(K)	(100)
Stonecutter St - Spindale @ West	0.14	21	60	2	10,000	1,400	5,300	(K)	(100)
Pea Ridge Rd (SR 1561)									
NPAB - Bostic Rd	0.90	18-20	60	2	10,000	1,400	2,200	(K)	(100)
Piedmont Rd (SR 1163)									
NC 108 - WPAB	1.70	18	60	2	8,500	550	1,300	(K)	(100)
Pine Street (SR 1903)									
US 221A - Mount Pleasant Church	1.50	22	60	2	11,000	3,600	4,800	(K)	(100)
Piney Ridge Rd (SR 2159)									
Oakland Rd - Butler Rd	1.70	18	60	2	8,500	5,400	9,000	(K)	(100)
Butler Rd - Bethany Rd	1.05	18	60	2	8,500	4,700	6,900	(K)	(100)
Pointer Rd (SR 2160)									
Doggett Rd - US 221 A	1.25	17	60	2	8,500	1,400	2,300	(K)	(100)
Poors Ford Rd (SR 1004, SR 2194)									
Oakland Rd - US 221	1.44	20	60	2	10,000	3,800	2,000	(K)	(100)
US 221 - SPAB	1.15	20	60	2	10,000	4,000	5,600	(K)	(100)
Poplar St/Florida Ave									
Spindale St - Ledbetter Rd			SEE FLORIDA AVENUE						
Railroad Ave (US 74 A)									
Waterworks Rd - US 64	0.57	24	60	2	12,000	4,500	5,500	(K)	(100)
US 64 - US 74 Bus/Charlotte Rd			SEE US 74 A/RAILROAD AVE						
Ridge Crest Rd (SR 1549)									
Hudlow Rd - Forest Lake Rd	0.62	18	60	2	8,500	900	2,000	(K)	(100)
Ridgecrest St (SR 1166)									
Maple Creek Rd - NC 108	1.10	21	60	2	10,500	2,200	4,000	(K)	(100)

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Thoroughfare Plan Street Tabulation and Recommendation

FACILITY & SECTION	ENGLISH UNITS DIST MI	RDWY FT	ROW FT	NUMBER OF LANES	PRACTICAL CAPACITY CURRENT (FUTURE)	1,997 ADTS	2,010 ADTS	RECOMMENDED X - SECTION RDWY (ULT)	ROW (ULT)
Robinson Rd (SR 2171)									
US 221 -Oakland Rd	1.08	20	60	2	10,000	400	1,000	(K)	(100)
Rock Road (SR 1520)									
Waterworks Rd - Broyhill Rd	0.20	20	60	2	10,000	1,400	3,000	(K)	(100)
Broyhill Rd - NPAB	0.50	20	60	2	10,000	1,000	2,500	(K)	(100)
Second Street (East)									
US 221 - Cleghorn St	0.13	24	60	2	10,000	2,000	3,000	ADQ	ADQ
Cleghorn St - US 74 A	0.75	24	60	2	10,000	1,000	2,000	ADQ	ADQ
Smith Grove Rd (SR 1551)									
US 74 Bus - East-West Conn	1.00	20	60	2	10,000	2,100	3,600	(K)	(100)
East-West Conn - Hudlow Rd	0.43	20	60	2	10,000	2,100	800	(K)	(100)
Spindale St (SR 1546)									
Whitesides Rd - West St	1.41	20	60	2	10,000	1,400	3,000	(K)	(100)
West St - US 74 Bus	0.55	28	60	2	12,000	3,600	5,400	ADQ	ADQ
Sunset Memorial Rd (SR 2179)									
Oakland Rd - Butler Rd	0.83	18	60	2	8,500	780	1,200	(K)	(100)
Tom Camp Rd (SR 1153)									
Union Rd - Cox Rd	1.20	18	60	2	8,500	330	800	(K)	(100)
Third Street (Rutherfordton)									
Ridgecrest St - Meridian St	0.30	18	60	2	8,500	500	1,000	(K)	(100)
Meridian St - US 221	0.20	24	60	2	12,000	500	1,000	ADQ	ADQ
Thompson Rd (SR 1367)									
US 221 - US 64	1.30	18	60	2	8,500	700	1,800	(K)	(100)
Thunder Rd (SR 2201)									
US 221 - US 221 Bypass	0.53	18	60	2	8,500	3,200	6,000	(K)	(100)
US 221 Bypass - US 74 A	1.07	18	60	2	8,500	2,800	3,000	(K)	(100)
Tryon Rd (NC 108)									
WPAB - Ridgecrest			SEE NC 108						
Union Rd (SR 1145)									
Tryon Rd - Edwards St Ext	1.20	18	60	2	8,500	570	800	(K)	(100)
Edwards St Ext - WPAB	0.50	18	60	2	8,500	350	800	(K)	(100)

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Thoroughfare Plan Street Tabulation and Recommendation

FACILITY & SECTION	ENGLISH UNITS DIST MI	RDWY FT	ROW FT	NUMBER OF LANES	PRACTICAL CAPACITY CURRENT (FUTURE)	1,997 ADTS	2,010 ADTS	RECOMMENDED X - SECTION RDWY (ULT)	ROW (ULT)
Vance St (Horns Bottom Rd (SR 1585)									
US 74 Bus - Old Lincoln Rd			SEE Horn Bottom Rd						
Washington St (US 74 Bus)									
US 64 - Maple St (Rutherfordton			SEE US 74 Bus						
Waterworks Rd (SR 1537)									
Old Hwy 221 - Rock Rd	0.08	20	60	2	8,500	2,900	4,700	(K)	(100)
West Street (SR 1544)									
US 74 A - Spindale St	0.80	20	60	2	[12000]	3,300	10,000	K	100
West St Extension (West)									
US 74 A - Cleghorn St	0.72			2	[12000]		6,700	K	100
Cleghorn St - US 221	0.13			2	[12000]		6,200	K	100
West St Ext (East West Connector)									
Spindale St - Park St	0.66			2	[12000]		5,300	K	100
Park St - Ledbetter Rd	0.53			2	[12000]		4,700	K	100
Ledbetter Rd - Hudlow Rd	1.44			2	[12000]		10,000	K	100
Hudlow Rd - Horn Bottom Rd	1.83			2	[12000]		5,500	K	100
Horn Bottom Rd - Old Bostic	0.52			2	[12000]		10,000	K	100
Old Bostic Rd - Bostic Rd	0.82			2	[12000]		10,000	K	100
Bostic Rd - Gun Club Rd	1.26			2	[12000]		8,400	K	100
Westview St									
Hardin Rd - US 74 Bus	0.26	20	60	2	10,000	5,300	6,800	(K)	(100)
Westwood St									
West St - Oak St	0.73	20	60	2	10,000	2,000	3,000	(K)	(100)
Withrow Rd (SR 2185)									
Oakland Rd - US 74 Bus	2.17	20	60	2	10,000	4,000	7,000	(K)	(100)
Whitesides Rd (SR 1538)									
US 74 A - Spindale St	1.55	20	60	2	10,000	1,700	2,500	(K)	(100)
Spindale St - NPAB	0.80	20	60	2	10,000	1,700	4,000	(K)	(100)

Appendix C

Typical Cross Sections

Cross section requirements for thoroughfares vary according to the desired capacity and level of service to be provided. Universal standards in the design of thoroughfares are not practical. Each street section must be individually analyzed and its cross section requirements determined on the basis of amount and type of projected traffic, existing capacity, desired level of service, and available right-of-way. Typical cross section recommendations are shown in Figure C-1. These cross sections are typical for facilities on new location and where right-of-way constraints are not critical. For widening projects and urban projects with limited right-of-way, special cross sections should be developed that meet the needs of the project.

The recommended typical cross sections shown in Appendix B, Table B-1 were derived on the basis of projected traffic, existing capacities, desirable levels of service, and available right-of-way.

On all existing and proposed major thoroughfares delineated on the thoroughfare plan, adequate right-of-way should be protected or acquired for the ultimate cross sections. Ultimate desirable cross sections for each of the thoroughfares are listed in Appendix B. Recommendations for "ultimate" cross sections are provided for the following:

1. thoroughfares which may require widening after the current planning period
2. thoroughfares which are borderline adequate and accelerated traffic growth could render them deficient
3. thoroughfares where an urban curb and gutter cross section may be locally desirable because of urban development or redevelopment.

Recommended design standards relating to grades, sight distances, degree of curve, super elevation, and other considerations for thoroughfares are given in Appendix D.

A - Four Lanes Divided with Median - Freeway

Typical for controlled access freeways. The 46 foot grassed median is the minimum median width. Wider variations could result depending upon design considerations.

B - Seven Lanes - Curb & Gutter

This cross section is not recommended for new projects. When the conditions warrant six lanes, cross section "D" should be recommended. Cross section "B" should be used only in special situations such as when widening from a five lane section and right-of-way is limited. Even in these situations, consideration should be given to converting the center turn lane to a median so that cross section "D" is the final cross section.

C - Five Lanes - Curb & Gutter

Typical for major thoroughfares, this cross section is desirable where frequent left turns are anticipated as a result of abutting development or frequent street intersections.

D - Six Lanes Divided with Raised Median - Curb & Gutter/ E - Four Lanes Divided with Raised Median - Curb and Gutter

These cross sections are typically used on major thoroughfares where left turns and intersection streets are not as frequent. Left turns would be restricted to a few selected intersections. The 4.8 m (16 ft) median is the minimum recommended for an urban boulevard type cross section. most instances, monolithic construction should be utilized due to greater cost effectiveness, ease and speed of placement, and reduced future maintenance requirements. In special cases, grassed or landscaped medians result in greatly increased maintenance costs and an increase danger to maintenance personnel. Non-monolithic medians should only be recommended when the above concerns are addressed.

F - Four Lanes Divided - Boulevard, Grass Median

Recommended for urban boulevards or parkways to enhance the urban environment and to improve the compatibility of major thoroughfares with residential areas. A minimum median width of 7.3 m (24 ft) is recommended with 9.1 m (30 ft) being desirable.

G - Four Lanes - Curb & Gutter

This cross section is recommended for major thoroughfares where projected travel indicates a need for four travel lanes but traffic is not excessively high, left turning movements are light, and right-of-way is restricted. An additional left turn lane would probably be required at major intersections. This cross section should be used only if the above criteria is met. If right-of-way is not restricted, future strip development could take place and the inner lanes could become de facto left turn lanes.

H - Three Lanes - Curb & Gutter

In urban environments, thoroughfares which are proposed to function as one-way traffic carriers would typically require cross section "H".

I - Two Lanes - C&G, Parking both sides: J - Two Lanes - C&G, Parking one side

Cross section "I" and "J" are usually recommended for urban minor thoroughfares since these facilities usually serve both land service and traffic service functions. Cross section "I" would be used on those minor thoroughfares where parking on both sides is needed as a result of more intense development.

K - Two Lanes - Paved Shoulder

This cross section is used in rural areas or for staged construction of a wider multi-lane cross section. On some thoroughfares, projected traffic volumes may indicate that two travel lanes will adequately serve travel for a considerable period of time. For areas that are growing and future widening will be necessary, the full right-of-way of 30 m (100 ft) should be required. In some instances, local ordinances may not allow the full 30 m. In those cases, 21 m (70 ft) should be preserved with the understanding that the full 30 m will be preserved by use of building setbacks and future street line ordinances.

L - Six Lanes Divided with Grass Median - Freeway

Cross section "L" is typical for controlled access freeways. The 14 m (46 ft) grassed median is the minimum desirable median width, but there could be some variation from this depending upon design considerations. Right-of-way requirements would typically vary upward from 70 m (228 ft) depending upon cut and fill requirements.

M - Eight Lanes Divided with Raised Median - Curb & Gutter

Also used for controlled access freeways, this cross section may be recommended for freeways going through major urban areas or for routes projected to carry very high volumes of traffic.

N - Five Lanes/C&G, Widened Curb Lanes; O - Two Lane/Shoulder Section; P - Four Lanes Divided/Raised Median, C&G, Widened Curb Lanes

If there is sufficient bicycle travel along the thoroughfare to justify a bicycle lane or bikeway, additional right-of-way may be required to contain the bicycle facilities. The North Carolina Bicycle Facilities Planning and Design Guidelines should be consulted for design standards for bicycle facilities. Cross sections "N", "O", and "P" are typically used to accommodate bicycle travel.

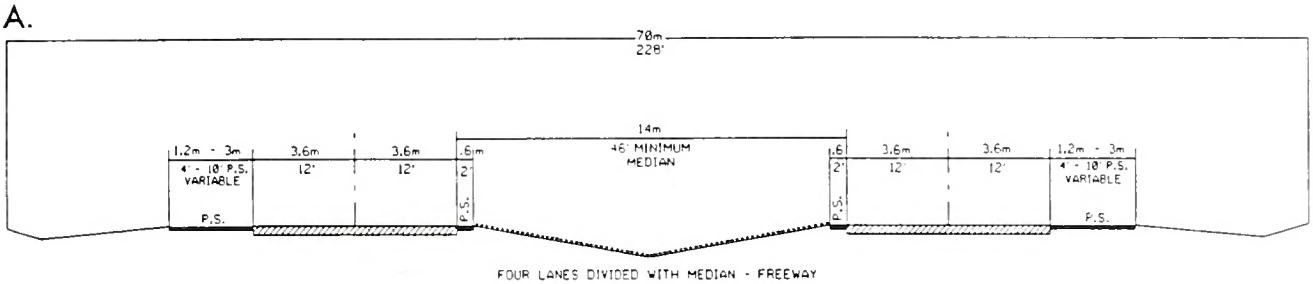
General

The urban curb and gutter cross sections all illustrate the sidewalk adjacent to the curb with a buffer or utility strip between the sidewalk and the minimum right-of-way line. This permits adequate setback for utility poles. If it is desired to move the sidewalk farther away from the street to provide additional separation for pedestrians or for aesthetic reasons, additional right-of-way must be provided to insure adequate setback for utility poles.

The right-of-ways shown for the typical cross sections are the minimum right-of-way required to contain the street, sidewalks, utilities, and drainage facilities. Cut and fill requirements may require either additional right-of-way or construction easements. Obtaining construction easements is becoming the more common practice for urban thoroughfare construction.

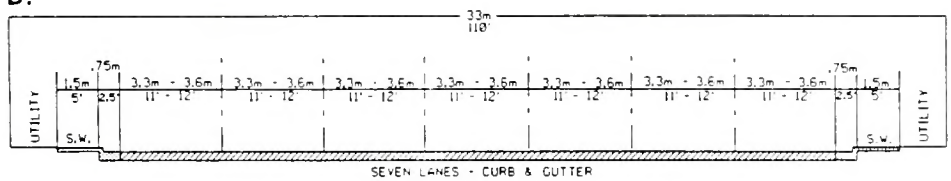
TYPICAL THOROUGHFARE CROSS SECTIONS

A.



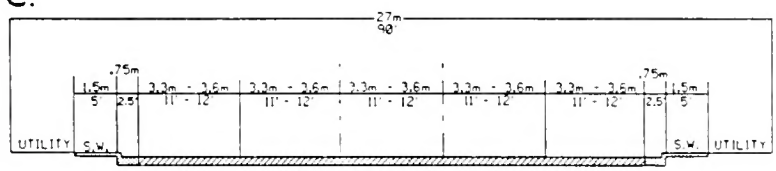
FOUR LANES DIVIDED WITH MEDIAN - FREEWAY

B.



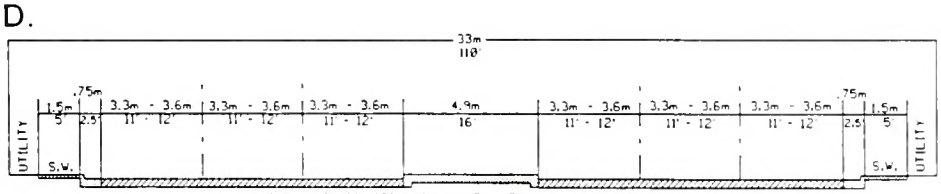
SEVEN LANES - CURB & GUTTER

C.



FIVE LANES - CURB & GUTTER

D.

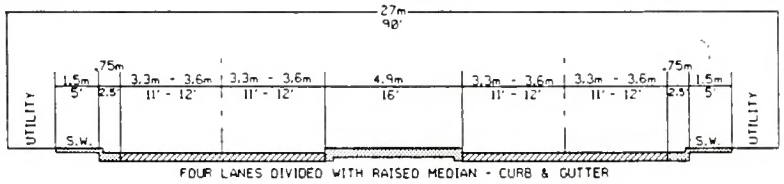


SIX LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

FIGURE C-1

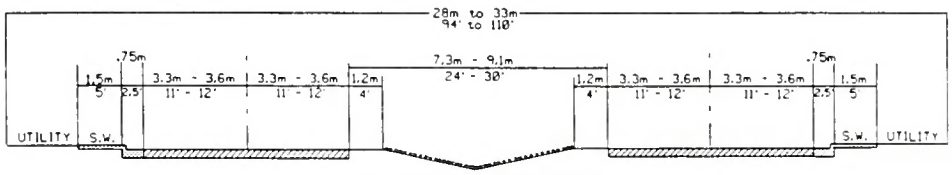
TYPICAL THOROUGHFARE CROSS SECTIONS

E.



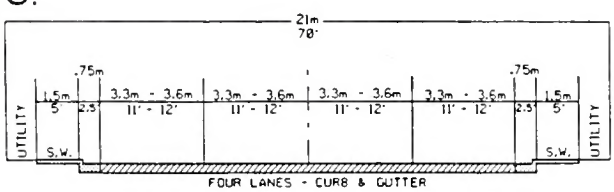
FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

F.



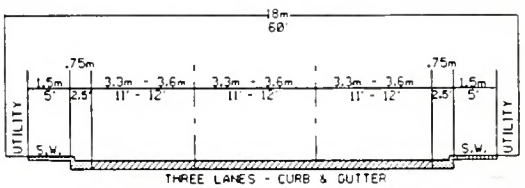
FOUR LANES DIVIDED - BOULEVARD
GRASS MEDIAN

G.



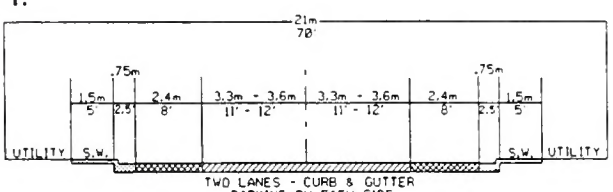
FOUR LANES - CURB & GUTTER

H.



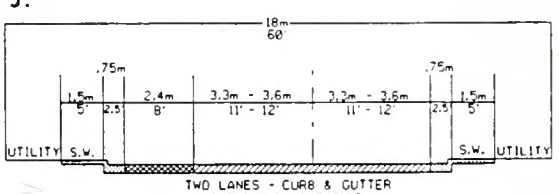
THREE LANES - CURB & GUTTER

I.



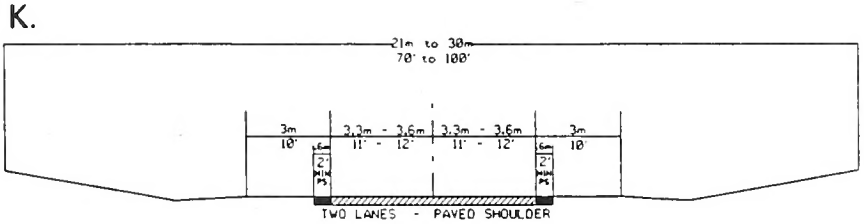
TWO LANES - CURB & GUTTER
PARKING ON EACH SIDE

J.



TWO LANES - CURB & GUTTER
PARKING ON ONE SIDE

K.

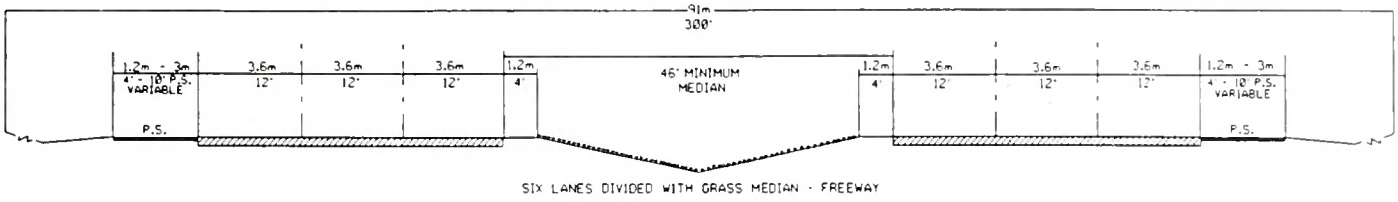


TWO LANES - PAVED SHOULDER

FIGURE C

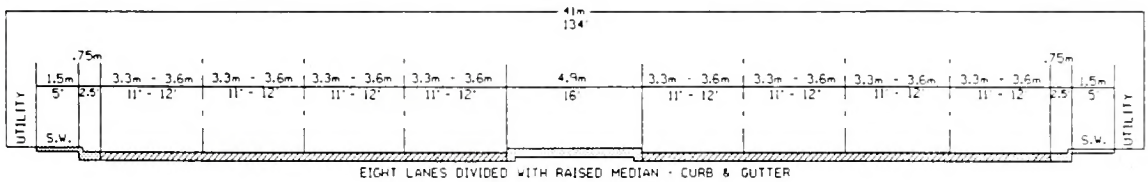
TYPICAL THOROUGHFARE CROSS SECTIONS

L.



SIX LANES DIVIDED WITH GRASS MEDIAN - FREEWAY

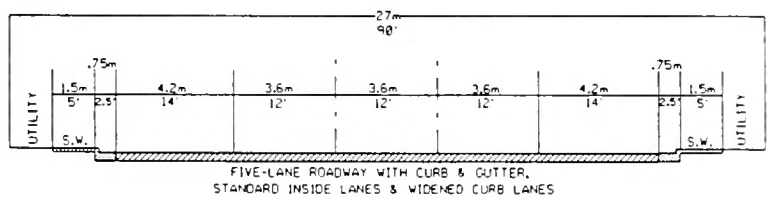
M.



EIGHT LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

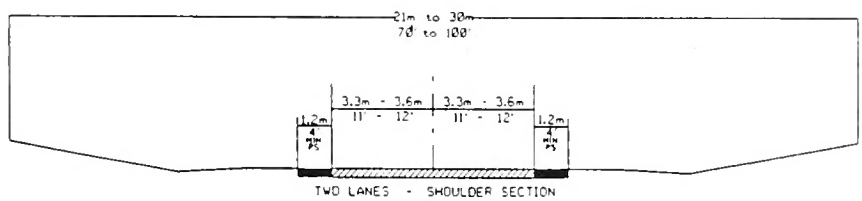
TYPICAL THOROUGHFARE CROSS SECTIONS FOR ACCOMMODATING BICYCLES

N.



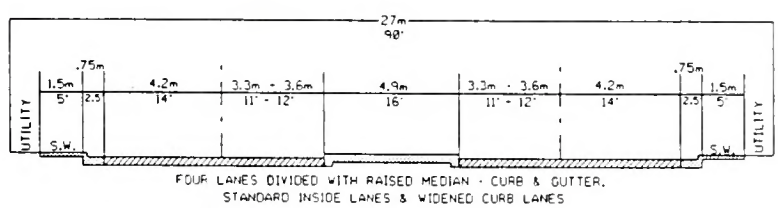
FIVE-LANE ROADWAY WITH CURB & GUTTER.
STANDARD INSIDE LANES & WIDENED CURB LANES

O.



TWO LANES - SHOULDER SECTION

P.



FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER.
STANDARD INSIDE LANES & WIDENED CURB LANES

FIGURE C-1

Appendix D

Recommended Subdivision Ordinances

Definitions

Streets and Roads

Rural Roads

1. *Principal Arterial* - A rural link in a highway system serving travel, and having characteristics indicative of substantial statewide or interstate travel and existing solely to serve traffic. This network would consist of Interstate routes and other routes designated as principal arterials.

2. *Minor Arterial* - A rural roadway joining cities and larger towns and providing intra-state and inter-county service at relatively high overall travel speeds with minimum interference to through movement.

3. *Major Collector* - A road which serves major intra-county travel corridors and traffic generators and provides access to the Arterial system.

4. *Minor Collector* - A road which provides service to small local communities and traffic generators and provides access to the Major Collector system.

5. *Local Road* - A road which serves primarily to provide access to adjacent land, over relatively short distances.

Urban Streets

1. *Major Thoroughfares* - Major thoroughfares consist of Inter-state, other freeway, expressway, or parkway roads, and major streets that provide for the expeditious movement of high volumes of traffic within and through urban areas.

2. *Minor Thoroughfares* - Minor thoroughfares perform the function of collecting traffic from local access streets and carrying it to the major thoroughfare system. Minor thoroughfares may be used to supplement the major thoroughfare system by facilitating minor through traffic movements and may also serve abutting property.

3. *Local Street* - A local street is any street not on a higher order urban system and serves primarily to provide direct access to abutting land.

Specific Type Rural or Urban Streets

1. *Freeway, expressway, or parkway* - Divided multilane roadways designed to carry large volumes of traffic at high speeds. A *freeway* provides for continuous flow of vehicles with no direct access to abutting property and with access to selected crossroads only by way of interchanges. An *expressway* is a facility with full or partial control of access and generally with grade separations at major intersections. A *parkway* is for non-commercial traffic, with full or partial control of access.

2. *Residential Collector Street* - A local street which serves as a connector street between local residential streets and the thoroughfare system. Residential collector streets typically collect traffic from 100 to 400 dwelling units.

3. *Local Residential Street* - Cul-de-sacs, loop streets less than 760 meters (2500 ft) in length, or streets less than 1.6 kilometers (1.0 miles) in length that do not connect thoroughfares, or serve major traffic generators, and do not collect traffic from more than 100 dwelling units.

4. *Cul-de-sac* - A short street having only one end open to traffic and the other end being permanently terminated and a vehicular turn-around provided.

5. *Frontage Road* - A road that is parallel to a partial or full access controlled facility and provides access to adjacent land.

6. *Alley* - A strip of land, owned publicly or privately, set aside primarily for vehicular service access to the back side of properties otherwise abutting on a street.

Property

Building Setback Line

A line parallel to the street in front of which no structure shall be erected.

Easement

A grant by the property owner for use by the public, a corporation, or person(s), of a strip of land for a specific purpose.

Lot

A portion of a subdivision, or any other parcel of land, which is intended as a unit for transfer of ownership or for development or both. The word "lot" includes the words "plat" and "parcel".

Subdivision

Subdivider

Any person, firm, corporation or official agent thereof, who subdivides or develops any land deemed to be a subdivision.

Subdivision

All divisions of a tract or parcel of land into two or more lots, building sites, or other divisions for the purpose, immediate or future, of sale or building development and all divisions of land involving the dedication of a new street or change in existing streets.

The following shall not be included within this definition nor subject to these regulations.

* The combination or re-combination of portions of previously platted lots where the total number of lots is not increased and the resultant lots are equal to or exceed the standards contained herein
* the division of land into parcels greater then 4 hectares (10 acres) where no street right-of-way dedication is involved

* the public acquisition, by purchase, of strips of land for the widening or the opening of streets
* the division of a tract in single ownership whose entire area is no greater than 0.8 hectares (2 acres) into not more than three lots, where no street right-of-way dedication is involved and where the resultant lots are equal to or exceed the standards contained herein.

Dedication

A gift, by the owner, of his property to another party without any consideration being given for the transfer. The dedication is made by written instrument and is completed with an acceptance.

Reservation

Reservation of land does not involve any transfer of property rights. It constitutes an obligation to keep property free from development for a stated period of time.

Design Standards

Streets and Roads

The design of all roads within the Planning Area shall be in accordance with the accepted policies of the North Carolina Department of Transportation, Division of Highways, as taken or modified from the American Association of State Highway and Transportation Officials' (AASHTO) manuals.

The provision of street rights-of-way shall conform and meet the recommendations of the Thoroughfare Plan, as adopted by the municipality. The proposed street layout shall be coordinated with the existing street system of the surrounding area. Normally the proposed streets should be the extension of existing streets if possible.

Right-of-way Widths

Right-of-way (ROW) widths shall not be less than the following and shall apply except in those cases where (ROW) requirements have been specifically set out in the Thoroughfare Plan.

The subdivider will only be required to dedicate a maximum of 30 meters (100 ft) of right-of-way. In cases where over 30 meters (100 ft) of right-of-way is desired, the subdivider will be required only to reserve the amount in excess of 30 meters (100 ft). On all cases in which right-of-way is sought for a fully controlled access facility, the subdivider will only be required to make a reservation. It is strongly recommended that subdivisions provide access to properties from internal streets, and that direct property access to major thoroughfares, principle and minor arterials, and major collectors be avoided. Direct property access to minor thoroughfares is also undesirable.

A partial width right-of-way, not less then 18 meters (60 ft) in width, may be dedicated when adjoining undeveloped property that is owned or controlled by the subdivider; provided that the width of a partial dedication be such as to permit the installation of such facilities as may be necessary to serve abutting lots. When the said adjoining property is sub-divided, the remainder of the full required right-of-way shall be dedicated.

Table D-1

Minimum Right-of-way Requirements

Area Classification	Functional Classification	Minimum ROW
RURAL	Principle Arterial	Freeways- 105 m (350 ft) Other- 60 m (200 ft)
	Minor Arterial	30 m (100 ft)
	Major Collector	30 m (100 ft)
	Minor Collector	24 m (80 ft)
	Local Road	18 m[1] (60 ft)
URBAN	Major Thoroughfare	27 m (90 ft)
	Minor Thoroughfare	21 m (70 ft)
	Local Street	18 m[1] (60 ft)
	Cul-de-sac	variable[2]

[1]The desirable minimum right-of-way (ROW) is 18 meters (60 ft). If curb and gutter is provided, 15 meters (50 ft) of ROW is adequate on local residential streets.

[2]The ROW dimension will depend on radius used for vehicular turn around. Distance from edge of pavement of turn around to ROW should not be less than distance from edge of pavement to ROW on street approaching turn around.

Street Widths

Widths for street and road classifications other than local shall be as recommended by the Thoroughfare Plan. Width of local roads and streets shall be as follows:

1. *Local Residential*

    * Curb and Gutter section
        * 7.8 meters (26 ft), face to face curb
    * Shoulder section
        * 6.0 meters (20 ft) to edge of pavement, 1.2 meters (4 ft) for shoulders

2. Residential Collector

    * Curb and Gutter section
        * 10.2 meters (34 ft), face to face of curb
    * Shoulder section
        * 6.0 meters (20 ft) to edge of pavement, 1.8 meters (6 ft) for shoulders

Geometric Characteristics

The standards outlined below shall apply to all subdivision streets proposed for addition to the State Highway System or Municipal Street System. In cases where a subdivision is sought adjacent to a proposed thoroughfare corridor, the requirements of dedication and reservation discussed under Right-of-way shall apply.

1. *Design Speed* - The design speed for a roadway should be a minimum of 10 km/h (5 mph) greater than the posted speed limit. The design speeds for subdivision type streets are shown in Tables D-2 (metric) and D-3 (english).

2. *Minimum Sight Distance* - In the interest of public safety, no less than the minimum sight distance applicable shall be provided. Vertical curves that connect each change in grade shall be provided and calculated using the parameters set forth in Tables D-4 (metric) and D-5 (english).

3. *Superelevation* - Tables D-6 (metric) and D-7 (english) show the minimum radius and the related maximum superelevation for design speeds. The maximum rate of roadway superelevation (e) for rural roads with no curb and gutter is 0.08. The maximum rate of superelevation for urban streets with curb and gutter is 0.06, with 0.04 being desirable.

4. *Maximum and Minimum Grades*

    * the maximum grades in percent are shown in Table D-8 (metric) and D-9 (english)
    * minimum grade should not be less then 0.5%
    * grades for 30 meters (100 ft) each way from intersections (measured from edge of pavement) should not exceed 5%

Table D-2

Design Speeds (Metric)

Facility Type	Design Speed (km/h)		
	Desirable	Minimum	
		Level	Rolling
RURAL			
Minor Collector Roads (ADT Over 2000)	100	80	60
Local Roads[1] (ADT Over 400)	80	80	60
URBAN			
Major Thoroughfares[2]	100	60	60
Minor Thoroughfares	100	50	50
Local Streets	50	50	30

[1]Local Roads including Residential Collectors and Local Residential.

[2]Major Thoroughfares other than Freeways or Expressways.

Table D-3

Design Speeds (English)

Facility Type	Design Speed (mph) Desirable	Minimum Level	Minimum Rolling
RURAL			
Minor Collector Roads (ADT Over 2000)	60	50	40
Local Roads[1] (ADT Over 400)	50	*50	*40
URBAN			
Major Thoroughfares[2]	60	50	40
Minor Thoroughfares	40	30	30
Local Streets	30	**30	**20

Note: *Based on ADT of 400-750. Where roads serve a limited area and small number of units, can reduce minimum design speed. **Based on projected ADT of 50-250. (Reference NCDOT Roadway Design Manual page 1-1B)

[1]Local Roads including Residential Collectors and Local Residential.

[2]Major Thoroughfares other than Freeways or Expressways.

Table D-4

Sight Distance (Metric)

Design Speed (km/h)	Stopping Sight Distance (meters) Desirable	Minimum	Minimum K[1] Values (meters) Crest Curve	Sag Curve	Passing Sight Distance (meters) For 2-lanes
30	30	29.6	3	4	*
50	70	57.4	9	11	*
60	90	74.3	14	15	*
90	170	131.2	43	30	*
100	210	157.0	62	37	*

Note: General practice calls for vertical curves to be multiples of 10 meters. Calculated lengths shall be rounded up in each case. *Minimum passing distance for 2-lanes is currently under revision. (Reference NCDOT Roadway Metric Design Manual page 1-12 T-1)

[1]K is a coefficient by which the algebraic difference in grade may be multiplied to determine the length of the vertical curve which will provide the desired sight distance. Sight distance provided for stopped vehicles at intersections should be in accordance with "A Policy on Geometric Design of Highways and Streets, 1990".

Table D-5

Sight Distance (English)

Design Speed (mph)	Stopping Sight Distance (feet)		Minimum K[1] Values (feet)		Passing Sight Distance (feet)
	Desirable	Minimum	Crest Curve	Sag Curve	For 2-lanes
30	200	200	30	40	1100
40	325	275	60	60	1500
50	475	400	110	90	1800
60	650	525	190	120	2100

Note: General practice calls for vertical curves to be multiples of 50 feet. Calculated lengths shall be rounded up in each case. (Reference NCDOT Roadway Design Manual page 1-12 T-1)

[1]K is a coefficient by which the algebraic difference in grade may be multiplied to determine the length of the vertical curve which will provide the desired sight distance. Sight distance provided for stopped vehicles at intersections should be in accordance with "A Policy on Geometric Design of Highways and Streets, 1990".

Table D-6

Superelevation Table (Metric)

Design Speed	Minimum Radius of Maximum e[1]		
	e=0.04	e=0.06	e=0.08
50	100	90	80
65	175	160	145
80	280	250	230
100	490	435	395

[1]e = rate of roadway superelevation, meter per meter.

Table D-7

Superelevation Table (English)

Design Speed (mph)	Minimum Radius of Maximum e[1]			Maximum Degree of Curve		
	e=0.04	e=0.06	e=0.08	e=0.04	e=0.06	e=0.08
30	302	273	260	19 00'	21 00'	22 45'
60	573	521	477	10 00'	11 15'	12 15'
80	955	955	819	6 00'	6 45'	7 30'
100	1,637	1,432	1,146	3 45'	4 15'	4 45'

[1]e = rate of roadway superelevation, foot per foot

Note: (Reference NCDOT Roadway Design Manual page 1-12 T-6 thru T-8)

Table D-8

Maximum Vertical Grade (Metric)

Facility Type and Design Speed (km/h)	Minimum Grade in Percent		
	Flat	Rolling	Mountainous
RURAL			
Minor Collector Roads*			
30	7	10	12
50	7	9	10
65	7	8	10
80	6	7	9
100	5	6	8
110	4	5	6
Local Roads*[1]			
30	-	11	16
50	7	10	14
65	7	9	12
80	6	8	10
100	5	6	-
URBAN			
Major Thoroughfares[2]			
50	8	9	11
65	7	8	10
80	6	7	9
100	5	6	8
Minor Thoroughfares*			
30	9	12	14
50	9	11	12
65	9	10	12
80	7	8	10
100	6	7	9
110	5	6	7
Local Streets*			
30	-	11	16
50	7	10	14
65	7	9	12
80	6	8	10
100	5	6	-

Note: *For streets and roads with projected annual average daily traffic less than 250 or short grades less than 150 meters (500 ft) long, grades may be 2% steeper than the values in the above table. (Reference NCDOT Roadway Metric Design Manual page 1-12 T-3)

[1]Local Roads including Residential Collectors and Local Residential.

[2]Major Thoroughfares other than Freeways or Expressways.

Table D-9

Maximum Vertical Grade (English)

Facility Type and Design Speed (km/h)	Minimum Grade in Percent		
	Flat	Rolling	Mountainous
RURAL			
Minor Collector Roads*			
20	7	10	12
30	7	9	10
40	7	8	10
50	6	7	9
60	5	6	8
70	4	5	6
Local Roads*[1]			
20	-	11	16
30	7	10	14
40	7	9	12
50	6	8	10
60	5	6	-
URBAN			
Major Thoroughfares[2]			
30	8	9	11
40	7	8	10
50	6	7	9
60	5	6	8
Minor Thoroughfares*			
20	9	12	14
30	9	11	12
40	9	10	12
50	7	8	10
60	6	7	9
70	5	6	7
Local Streets*			
20	-	11	16
30	7	10	14
40	7	9	12
50	6	8	10
60	5	6	-

Note: *For streets and roads with projected annual average daily traffic less than 250 or short grades less than 150 meters (500 ft) long, grades may be 2% steeper than the values in the above table. (Reference NCDOT Roadway Metric Design Manual page 1-12 T-3)

[1]Local Roads including Residential Collectors and Local Residential.

[2]Major Thoroughfares other than Freeways or Expressways.

Intersections

1. Streets shall be laid out so as to intersect as nearly as possible at right angles, and no street should intersect any other street at an angle less than sixty-five (65) degrees.

2. Property lines at intersections should be set so that the distance from the edge of pavement, of the street turnout, to the property line will be at least as great as the distance from the edge of pavement to the property line along the intersecting streets. This property line can be established as a radius or as a sight triangle. Greater offsets from the edge of pavement to the property lines will be required, if necessary, to provide sight distance for the stopped vehicle on the side street.

3. Off-set intersections are to be avoided. Intersections which cannot be aligned should be separated by a minimum length of 60 meters (200 ft) between survey centerlines.

Cul-de-sacs

Cul-de-sacs shall not be more than one hundred and fifty (150) meters (500 ft) in length. The distance from the edge of pavement on the vehicular turn around to the right-of-way line should not be less than the distance from the edge of pavement to right-of-way line on the street approaching the turn around. Cul-de-sacs should not be used to avoid connection with an existing street or to avoid the extension of an important street.

Alleys

1. Alleys shall be required to serve lots used for commercial and industrial purposes except that this requirement may be waived where other definite and assured provisions are made for service access. Alleys shall not be provided in residential subdivisions unless necessitated by unusual circumstances.

2. The width of an alley shall be at least 6.0 meters (20 ft).

3. Dead-end alleys shall be avoided where possible, but if unavoidable, shall be provided with adequate turn around facilities at the dead-end as may be required by the Planning Board.

Permits for Connection to State Roads

An approved permit is required for connection to any existing state system road. This permit is required prior to any construction on the street or road. The application is available at the office of the District Engineer of the Division of Highways.

Offsets To Utility Poles

Poles for overhead utilities should be located clear of roadway shoulders, preferably a minimum of at least 9.0 meters (30 ft) form the edge of pavement. On streets with curb and gutter, utility poles shall be set back a minimum distance of 1.8 meters (6 ft) from the face of curb.

Wheel Chair Ramps

All street curbs being constructed or reconstructed for maintenance purposes, traffic operations, repairs, correction of utilities, or altered for any reason, shall provide wheelchair ramps for the physically handicapped at intersections where both curb and gutter and sidewalks are provided and at other major points of pedestrian flow.

Horizontal Width on Bridge Deck

1. The clear roadway widths for new and reconstructed bridges serving 2 lane, 2 way traffic should be as follows:

   * shoulder section approach

      * under 800 ADT design year - minimum 8.4 meters (28 ft) width face to face of parapets, rails, or pavement width plus 3 meters (10 ft), whichever is greater.

      * 800 - 2000 ADT design year - minimum 10.2 meters (34 ft) width face to face of parapets, rails, or pavement width plus 3.6 meters (12 ft), whichever is greater

      * over 2000 ADT design year - minimum width of 12 meters (40 ft), desirable width of 13.2 meters (44 ft) width face to face of parapets or rails

   * curb and gutter approach

      * under 800 ADT design year - minimum 7.2 meters (24 ft) face to face of curbs

      * over 800 ADT design year - with of approach pavement measured face to face of curbs.

   * where curb and gutter sections are used on roadway approaches, curbs on bridges shall match the curbs on approaches in height, in width of face to face curbs, and in crown drop. The distance from face of curb to face of parapet or rail shall be a minimum of 450 millimeters (1' 6"), or greater if sidewalks are required.

2. The clear roadway widths for new and reconstructed bridges having 4 or more lanes serving undivided two-way traffic should be as follows:

   * shoulder section approach - Width of approach pavement plus width of usable shoulders on the approach left and right. (shoulder width 2.4 m (8 ft) minimum, 3 m (10 ft) desirable.)

   * curb and gutter approach - Width of approach pavement measured face to face of curbs.

Appendix E

Planning Area Housing and Employment Data

Zone	1997 Employment	2010 Employment	1997 Housing	2010 Housing
1	323	323	0	0
2	150	150	0	0
3	376	376	2	0
4	60	60	137	139
5	54	54	35	35
6	3	3	63	63
7	3	3	83	83
8	284	284	28	28
9	15	15	109	111
10	24	24	193	197
11	166	166	415	423
12	0	0	21	21
13	2	2	126	128
14	116	116	217	283
15	0	48	83	107
16	0	48	15	19
17	383	383	31	41
18	172	172	28	36
19	38	38	200	260
20	106	106	240	264
21	65	65	507	609
22	0	126	22	24
23	26	158	138	208
24	69	117	262	393
25	190	316	0	0
26	927	1053	81	89
27	2	2	43	51
28	34	34	77	98
29	4	4	6	8
30	0	0	14	18
31	0	0	11	15
32	0	0	297	387
33	193	193	176	212
34	658	784	128	140
35	13	61	57	63
36	957	1005	136	150
37	0	0	152	212

Appendix E (Continued)

Planning Area Housing and Employment Data

Zone	1997 Employment	2010 Employment	1997 Housing	2010 Housing
38	0	0	86	120
39	1	1	53	75
40	1	1	109	153
41	4	4	13	19
42	0	0	21	19
43	1	127	11	15
44	0	0	66	86
45	19	145	51	67
46	46	46	34	44
47	2	2	38	42
48	57	105	1	1
49	90	90	0	0
50	0	0	147	191
51	12	12	75	105
52	10	10	100	150
53	161	161	0	0
54	75	201	0	0
55	0	0	0	0
56	124	249	28	28
57	4	129	0	0
58	68	116	221	243
59	4	52	143	244
60	8	56	36	40
61	1052	1100	77	77
62	26	100	9	9
63	72	120	142	156
64	49	49	72	80
65	633	633	87	95
66	0	0	17	21
67	7	7	156	188
68	64	64	227	273
69	54	87	192	212
70	2024	2072	0	0
71	10	58	70	70
72	1	1	53	59
73	0	0	24	32
74	403	403	139	181

Appendix E (Continued)

Planning Area Housing and Employment Data

Zone	1997 Employment	2010 Employment	1997 Housing	2010 Housing
75	70	70	78	102
76	184	184	111	145
77	29	157	34	48
78	1	1	80	104
79	20	145	117	163
80	2	127	35	48
81	114	114	37	49
82	131	179	216	260
83	233	281	6	6
84	108	108	90	100
85	12	12	56	72
86	17	65	87	121
87	361	361	13	13
88	6	6	229	251
89	65	365	102	112
90	279	579	7	7
91	237	360	321	481
92	0	125	246	370
93	4	4	104	166
94	0	0	53	79
95	1	1	55	83
96	31	31	13	15
97	470	470	23	23
98	128	128	89	97
99	227	227	13	15
100	204	204	220	264
101	154	154	61	61
102	2	2	96	106
103	151	151	66	72
104	59	106	70	78
105	33	33	146	160
106	2	2	117	163
107	27	27	66	92
108	143	444	139	195
109	463	463	0	0
110	427	427	37	49
111	467	467	35	45

Appendix E (Continued)

Planning Area Housing and Employment Data

Zone	1997 Employment	2010 Employment	1997 Housing	2010 Housing
112	19	19	123	159
113	7	7	139	176
114	395	519	65	85

Appendix F

Pedestrian Policy Guidelines

Executive Summary

These guidelines provide a procedure for implementing the Pedestrian Policy adopted by the Board of Transportation in August 1993. The pedestrian Policy addresses TIP projects and makes an important distinction between "considering the needs of pedestrians to avoid creating hazards to pedestrian movements" and the concept of "facilitating pedestrian movements for other reasons."

Hazards

A hazard in this context is defined as a situation when pedestrian movements are physically blocked in a manner which forces pedestrians to use another mode of transportation or walk in an automobile traffic lane (parallel with the automobile traffic) to pass a barrier. The concept of "not creating a hazard" is intended to allow municipalities to have the flexibility to add pedestrian facilities as part of the project, or in the future after the TIP project is complete. Our current standard cross sections generally do not create barriers for pedestrian movements. One exception is on urban bridges where the bridge rail is at the back of the curb.

Quantifying the need for Pedestrian Facilities

Planning studies should evaluate the need for pedestrian facilities based on the degree to which the following criteria are met.

1. Local Pedestrian Policy
2. Local Government Commitment
3. Continuity and Integration
4. Locations
5. Generators
6. Safety
7. Existing or Projected Pedestrian Traffic

Requirements for DOT Funding

Replacing Existing Sidewalks

The DOT will pay 100% of the cost to replace an existing sidewalk which is removed to make room for a widening project.

Preventing Hazards

If there is evidence that a TIP project would create a hazard to existing pedestrian movements, the DOT will take the initiative to not create the hazard. However, if there is not evidence that a TIP project would create a hazard to existing pedestrian movements, the municipality will need to prove there will be pedestrian movements which will be affected within five years by the hazard created by the TIP project.

Incidental Projects

Due to the technical difficulty of describing justification for pedestrian facilities, the committee chose a cost sharing approach to provide cost containment for the pedestrian facilities. The DOT may share the incremental cost of constructing the pedestrian facilities if the "intent of the criteria" are met. The DOT will pay a matching share of incidental pedestrian facility total construction costs up to a cap of no more than 2% of total project construction cost. The matching share is a sliding scale based on population as follows:

Table F-1

Incidental Projects Cost Participation Break Down

Municipal Population	Participation	
	DOT	Local
> 100,000	50%	50%
50,000 to 100,000	60%	40%
10,000 to 50,000	70%	30%
< 10,000	80%	20%

Funding Caps

Under normal circumstances, the cumulative funding for preventing hazards and providing incidental pedestrian facilities should not exceed 2% of the total project construction cost.

Independent Projects

The DOT will have a separate category of money for all independent pedestrian facility projects in North Carolina. The independent pedestrian facility funds will be administered similar to the Bicycle Program.

Right-of-Way

In general, municipalities are responsible for providing any right-of-way needed to construct pedestrian facilities. However, the 2.4 meter (8 foot) berm the DOT generally provides on urban curb and gutter facilities can accommodate pedestrian facilities.

Maintenance

Local governments will be responsible for maintaining all pedestrian facilities.

For further information about the Pedestrian Policy Guidelines please contact the following:

Statewide Planning Branch
NC Department of Transportation
P.O. Box 25201
Raleigh, NC 27611
(919) 733-4705

Appendix G

US 221 Bypass Alternative Routes

This appendix briefly shows the different routes and the cost estimates that were investigated in developing the US 221 Bypass Alternative Routes. Figure G-1 shows the alternative routes that correspond with the cost estimate comparison for the project. Alternative A is the preferred eastern route and is funded in the TIP (Project R-2233). Alternative B is to widen existing US 221. Alternative C is the western route with a connector to US 74 A which was in the previous thoroughfare plan.

Table G-1

US 221 Bypass Alternative Routes and Cost Estimates

Project	Length (miles)	Cost (millions)
• Alternative A - eastern route	7.52	$44.0
• Alternative B - widen existing US 221	7.38	$17.0
• Alternative C - western route	5.30	$39.1

Alternative A is the most expensive route, but will provide the most benefit for the Rutherford County Urban Area since it is more central to the planning area. Also, Alternative A is a longer route, bypassing more of the planning area than Alternative C. Alternative B is the least expensive alternative; however, it would be very disruptive to the planning area to widen US 221 due to the neighborhoods and the heavily developed downtown area in Rutherfordton along US 221. Alternative C is less expensive than Alternative A, but would not serve the planning area as well since it is in the far western portion of the area. Alternative C would not carry as much traffic as Alternative A and would not alleviate as much traffic from US 221. Alternative A would alleviate through truck traffic from US 221, benefiting those who travel, live, and work along US 221. Alternative A would also enhance truck access to the industrial areas northeast and southeast of Rutherfordton; therefore, there is the potential for industrial growth in the area. Clearly, Alternative A is the preferred corridor for the US 221 Bypass.

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COST ESTIMATES
US 221 BYPASS
ALTERNATIVES

ALTERNATIVE A

ALTERNATIVE B

ALTERNATIVE C

MAJOR THOROUGHFARE

INTERCHANGE

GRADE SEPARATION

FIGURE G-1

N

S

RUTHERFORD COUNTY
URBAN AREA

RUTHERFORD COUNTY

NORTH CAROLINA

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS - STATEWIDE PLANNING BRANCH
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

0 2000 4000 6000 8000
feet

0 1000 2000 3000
kilometers